

Common Sleep Disorders

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Intro

AGC's ApLab™ system consists of a precision data acquisition unit and a software data processing application (ApLab Viewer™). The simple to use data acquisition unit acquires a precise record of a patient's breathing while he/she sleeps at home. The ApLab Viewer processes the breathing data and calculates an RDI index for sleep-disordered breathing. The summary information, when combined with our industry recognized screening questionnaire assists the physician in treatment decisions. This interpretation guide discusses sleep, associated disorders, methods of detection, interpretation, and treatment options.

Sleep

Sleep Stages

Since the early 20th century, human sleep has been described as a succession of five recurring stages: four non-REM stages and the REM stage. A sixth stage, waking, is often included. Waking, in this context, is actually the phase during which a person falls asleep. Rapid eye movement (REM) sleep is marked by extensive physiological changes, such as accelerated respiration, increased brain activity, eye movement, and muscle relaxation. People dream during REM sleep, perhaps as a result of excited brain activity and the paralysis of major voluntary muscles.

Sleep quality changes with transition from one sleep stage into another. Although the signals for transition between the five (or six) stages of sleep are mysterious, it is important to remember that these stages are, in fact, discretely independent of one another, each marked by subtle changes in bodily function and each part of a predictable cycle whose intervals are observable. Sleep stages are monitored and examined clinically with polysomnography, which provides data regarding electrical and muscular states during sleep. For ideas on how to sleep better see Appendix A.

Waking

The waking stage is referred to as relaxed wakefulness, because this is the stage in which the body prepares for sleep. All people fall asleep with tense muscles, their eyes moving erratically. Then, normally, as a person becomes sleepier, the body begins to slow down. Muscles begin to relax, and eye movement slows to a roll.

Stage 1

Stage 1 sleep comprises about 2% to 5% of sleep, or drowsiness, is often described as first in the sequence, especially in models where waking is not included. Polysomnography shows a 50% reduction in activity between wakefulness and stage 1 sleep. The eyes are closed during Stage 1 sleep, but if aroused from it, a person may feel as if he or she has not slept. Stage 1 may last for five to 10 minutes.

Stage 2

Stage 2 sleep comprises about 45% to 50% of sleep, is a period of light sleep during which polysomnography readings show intermittent peaks and valleys, or positive and negative waves. These waves indicate spontaneous periods of muscle tone mixed with periods of muscle relaxation. Muscle tone of this kind can be seen in other stages of sleep as a reaction to auditory stimuli. The heart rate slows, and body temperature decreases. At this point, the body prepares to enter deep sleep.

Stages 3 and 4

Stage 3 comprises about 3% to 8% of sleep. Stage 4 comprises about 10% to 15% of sleep. These are deep sleep stages, with Stage 4 being more intense than Stage 3. These stages are known as slow-wave, or delta sleep. During slow-wave sleep, especially during Stage 4, the electroencephalogram records slow waves of high amplitude, indicating a pattern of deep sleep and rhythmic continuity.

Non-REM Sleep

The period of non-REM sleep (NREM) is comprised of Stages 1-4 that is usually 75% to 80% of sleep and lasts from 90 to 120 minutes per cycle, each stage lasting anywhere from 5 to 15 minutes.

Surprisingly, however, Stages 2 and 3 repeat backwards before REM sleep is attained. So, a normal sleep cycle has this pattern: waking, stage 1, 2, 3, 4, 3, 2, REM. Usually, REM sleep occurs 90 to 120 minutes after sleep onset.

Stage 5, REM

REM sleep is usually 20% to 25% of sleep occurring in four to six discrete episodes. Sleep is distinguishable from NREM sleep by changes in physiological states, including its characteristic rapid eye movements. However, polysomnograms show wave patterns in REM to be similar to Stage 1 sleep. In normal sleep (in people without disorders of sleep-wake patterns or REM behavior disorder), heart rate and respiration speed up and become erratic, while the face, fingers, and legs may twitch. Intense dreaming occurs during REM sleep as a result of heightened cerebral activity, but paralysis occurs simultaneously in the major voluntary muscle groups, including the submental muscles (muscles of the chin and neck). Because REM is a mixture of encephalic (brain) states of excitement and muscular immobility, it is sometimes called paradoxical sleep. It is generally thought that REM-associated muscle paralysis is meant to keep the body from acting out the dreams that occur during this intensely cerebral stage. The first period of REM typically lasts 10 minutes, with each recurring REM stage lengthening, and the final one lasting an hour.

Sleep Cycle

The five stages of sleep, including their repetition, occur cyclically. The first cycle, which ends after the completion of the first REM stage, usually lasts for 100 minutes. Each subsequent cycle lasts longer, as its respective REM stage extends. So a person may complete five cycles in a typical night's sleep.

Factors that Affect Sleep Stage and the Sleep Cycle

The sleep cycle is a variable, influenced by several agents. Sleep cycles subsequent to the first one in a night's sleep typically feature less slow-wave sleep, as Stages 3 and 4 shorten. Slow-wave, deep sleep is longest early in a night's sleep. Generally, sleep disorders affect the quality, duration, and onset of sleep. Sleep deprivation, frequently changing sleep schedule, stress, and environment all affect the progression of the sleep cycle. Rapid eye movement latency (the time it takes a person to achieve REM sleep) may be affected by a sleep disorder like narcolepsy. Psychological conditions like depression shorten the duration of rapid eye movement. Also, treatment for psychiatric conditions often positively affects sleep, typically inducing some desired change in sleep habit. For example, antidepressants like Prozac(r) usually quicken sleep onset and lengthen REM stages. People who take antidepressants often benefit from the effects they have on the quality and duration of the sleep cycle.

Age

The percentage of REM sleep is highest during infancy and early childhood, drops off during adolescence and young adulthood, and decreases further in older age. Of course, infants require the greatest amount of sleep. As parents know, total sleep time typically becomes shorter during childhood and may become longer again in adolescence. The stage-respective dimensions of sleep change relative to age. Stages 3 and 4 in the first sleep cycle shorten even more dramatically in older people than they do during a typical night for everyone else, so older people get less total deep sleep than younger people do. Also with age comes the lengthening of the first REM stage. Older people commonly enter REM sleep quicker and stay there longer.

Normal Sleep Architecture

For an individual who is living on a conventional sleep-wake schedule and who is without sleep complaints:

1. Sleep is entered through NREM.
2. NREM sleep and REM sleep alternate with a period near 90 minutes.
3. Slow wave sleep predominates in the first third of the night and is linked to the initiation of sleep.
4. REM sleep predominates in the last third of the night and is linked to the circadian rhythm of body temperature.
5. Wakefulness within sleep usually accounts for less than 5% of the night.
6. Stage 1 sleep generally comprises about 2% to 5% of sleep.
7. Stage 2 sleep generally comprises about 45% to 50% of sleep.
8. Stage 3 sleep generally comprises about 3% to 8% of sleep.
9. Stage 4 sleep generally comprises about 10% to 15% of sleep.
10. NREM sleep, therefore, is usually 75% to 80% of sleep.
11. REM sleep is usually 20% to 25% of sleep occurring in four to six discrete episodes

Sleep Disorders

There are more than 70 different sleep disorders that are generally classified into one of three categories:

- ⌚ lack of sleep (e.g., insomnia),
- ⌚ disturbed sleep (e.g., obstructive sleep apnea)
- ⌚ excessive sleep (e.g., narcolepsy)

In most cases, sleep disorders can be easily managed once they are properly diagnosed. Some of the most common disorders are described below. In depth descriptions and additional disorders may be found in Appendix A.

- ⌚ **Insomnia:** Many people associate insomnia with an inability to fall asleep, which in turn leads to Excessive Daytime Sleepiness (EDS). While difficulty falling asleep is one type of insomnia, frequent nighttime awakenings, poor quality rest and early awakening are also characteristic of the condition. Insomnia itself is not an actual disorder: it is a symptom of an underlying problem.
- ⌚ **Apnea:** Sleep apnea occurs when breathing passages are obstructed at night. A person with apnea stops breathing for periods of 10 seconds to 2 minutes throughout the night, leading to poor and fragmented rest. The lack of quality rest leads to EDS. Severe snoring or choking noises while asleep are common symptoms of apnea. Obesity, poor muscle tone, and alcohol consumption often worsen apnea symptoms. Over time, apnea can have negative effects on both slumber patterns and physical health. Controlling obesity, exercising regularly and limiting alcohol may help alleviate symptoms.
- ⌚ **Narcolepsy:** Narcolepsy is a neurological disorder that causes sudden shifts from wakefulness into sleep. EDS is a symptom of narcolepsy, and people often have "nap attacks" that can occur almost anywhere.
- ⌚ **Restless Legs Syndrome (RLS):** A deep feeling of pulling, itching, or "creeping" in the legs, especially when lying down, is a characteristic of restless legs syndrome. The feeling is almost impossible to ignore, and is alleviated slightly by moving the legs. Fragmented and poor quality rest due to constant leg motion leads to daytime fatigue and tiredness. A distinct disorder, which often occurs simultaneously with RLS, is Periodic Limb Movement Disorder (PLMD). PLMD is generally described as repetitive, involuntary movement during sleep, often resulting in arousal.

Traditional Sleep Diagnosis

Polysomnography (PSG) is traditionally used to diagnose Sleep Disorders. A PSG consists of a simultaneous recording of multiple physiologic parameters related to sleep and wakefulness. The recordings are used to evaluate abnormalities of sleep and/or wakefulness and other physiologic disorders that have an impact on or are related to sleep and/or wakefulness.

PSG reports generally consist of sleep time, disruption and stage statistics along with event (apneas, hypopneas) characterization and physiological data (heart rate, breathing rate, etc). A treatment recommendation is also commonly included. The common parameters generally contained in a PSG report are detailed below:

- ⌚ **Sleep Efficiency** (N > 90%): Total sleep time divided by total time in bed.
- ⌚ **Sleep Latency** (N = 10-20 minutes): Amount of time from lights out to first onset of sleep.
- ⌚ **REM Latency** (N = 90-120 minutes): Amount of time from sleep onset to first REM period.
- ⌚ **REM Sleep Percentage** (N > 20%): Total amount of REM sleep during sleep study. REM sleep episodes generally become longer through the night. This stage of sleep is usually affected most by sleep apnea because of muscle atonia (absence of tone).
- ⌚ **Apnea Count(s)**: Number of occurrences in which airflow is decreased by 75% for 10 seconds or more with a corresponding 4% or greater desaturation and/or arousal.
- ⌚ **Hypopnea Count(s)**: Number of occurrences in which airflow is decreased by 30% for 10 seconds or more with a corresponding 4% or greater desaturation and/or arousal.
- ⌚ **Apnea/Hypopnea Index**: (N < 5.0): The average number of A/H events per hour during the sleep study (also referred to as RDI or Respiratory Distress Index: Apnea, Hypopneas, & Respiratory Effort Related Arousals – RERA's). This parameter is used most to determine the severity of Obstructive Sleep Apnea. An index of 5 to 15 is indicative of mild Sleep Apnea. An index of 15 to 40 is indicative of moderate Sleep Apnea. An index of 40 or above is indicative of severe Sleep Apnea. It is important to understand, however, that the A/H index cannot be used alone to determine the severity of Sleep Apnea. You must also consider the severity of the oxygen desaturations and number of arousals and/or awakenings associated the apnea and hypopnea events.
- ⌚ **Diagnostic Impression**: Mild, moderate, or severe Obstructive Sleep Apnea, Restless Leg Syndrome, Periodic Leg Movement Syndrome or possible Narcolepsy. If a patient has excessive daytime sleepiness and early onsets of REM but low apnea/hypopnea index, non-severe oxygen desaturations, and/or few arousals/awakenings, he/she may have Narcolepsy. A Multiple Sleep Latency Test (MSLT) should be ordered to determine diagnosis of Narcolepsy. This test should always be preceded by an overnight polysomnogram to insure the patient has had sufficient sleep before this daytime study.
- ⌚ **Recommendations**: For Obstructive Sleep Apnea, a CPAP (Continuous Positive Airway Pressure) Titration should be ordered. CPAP therapy has been proven to be the most effective method of eliminating Obstructive Sleep Apnea. In the event that the patient cannot tolerate CPAP therapy, he/she should be referred to an ENT surgeon for possible debulking of the upper airway. Weight loss and body position changes during sleep can also be effective in treating Obstructive Sleep Apnea. For Restless Leg Syndrome and Periodic Leg Movement Syndrome, Clonazepam, Temazepam, Opiates, Levodopa, Sinemet, Tegretol, or Baclofen are usually prescribed. For Narcolepsy, Ritalin, Provigil or Cylert are usually prescribed.

The AGC Screening Questionnaire

AGC's Patient questionnaire is composed of demographics followed by two series of questions. The first is the Epworth Sleepiness scale, which has been used successfully in the industry for many years in quantifying patient sleepiness. Epworth scores range from 0 - 24, with patient sleepiness increasing with the score. The second questionnaire has been developed and applied by Sleep Centers to help characterize sleep disorders. The scores in this questionnaire are specific to common sleep disorders (sleep apnea, insomnia, narcolepsy, etc.).

Questionnaire(s) results are used to determine if an ApLab test is required. After an ApLab test has been performed, the questionnaire results may be utilized to determine further testing / treatment options.

The ApLab Report

Overview

The ApLab report is a detailed sleep health summary based upon the patients breathing characteristics. AGC's Event Detection Algorithm (EDA™), an integral part of the ApLab Viewer™ software application, processes the breathing data, characterizes discreet events (apneas & hypopneas), and performs all calculations.

Registered Sleep Technologists can validate each study utilizing the advanced tools of the ApLab Viewer prior to report generation. Sample breathing characteristics observed with the ApLab Viewer are shown in the following examples.

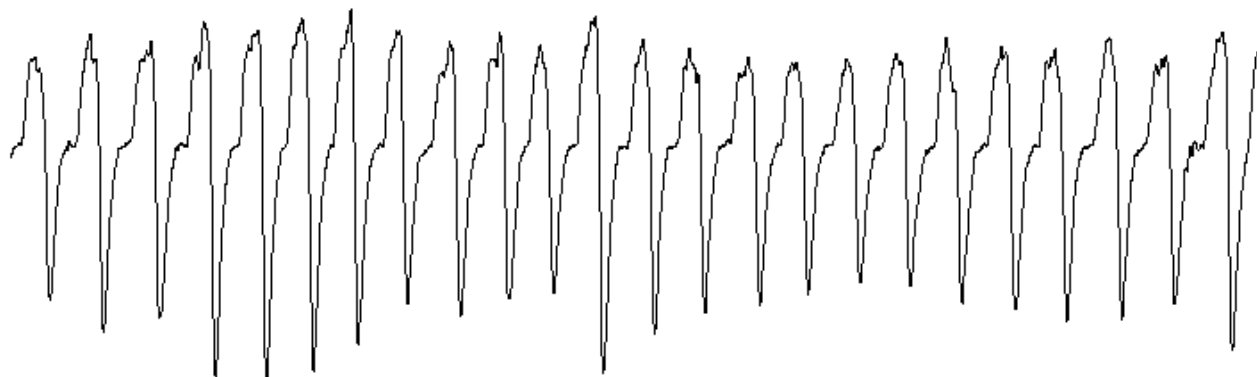


Figure 1: Normal breathing

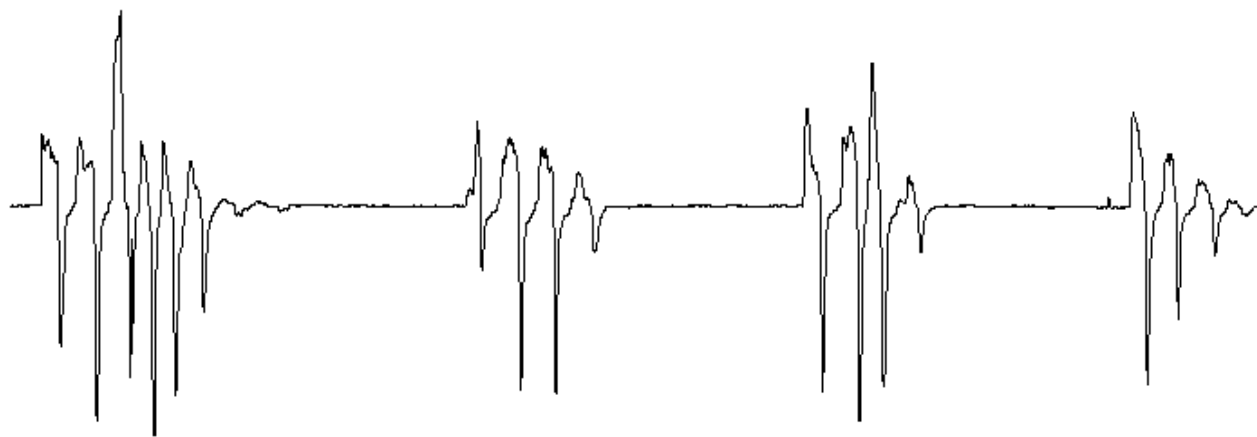


Figure 2: Obstructive Apnea

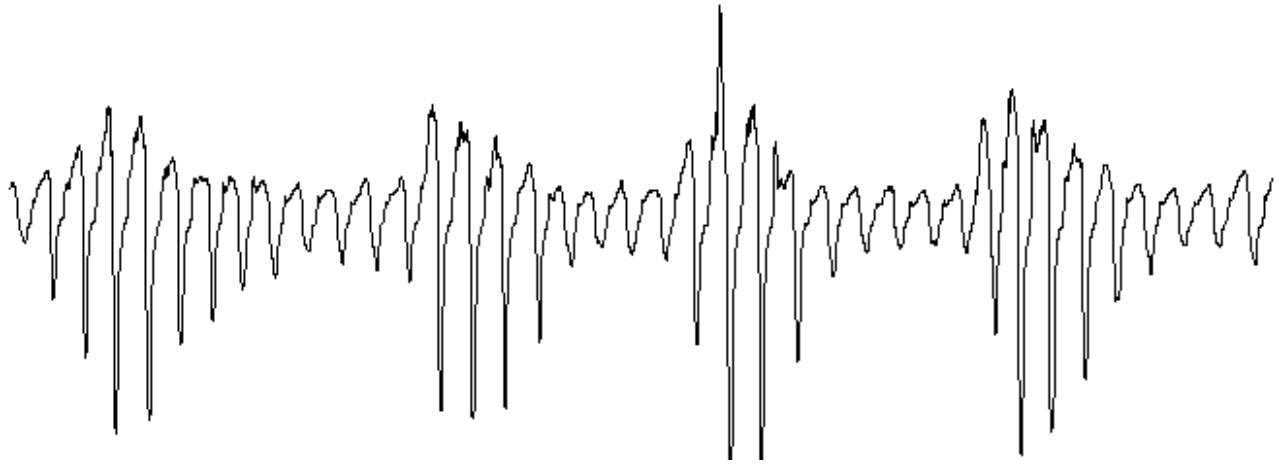


Figure 3: Hypopnea

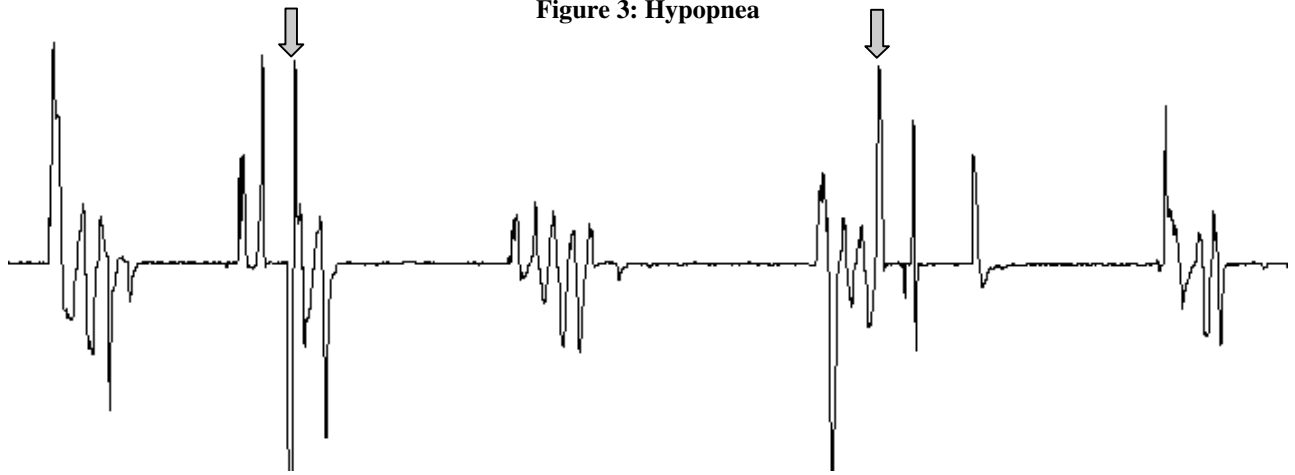


Figure 4: Respiratory Effort Related Arousals (RERA)

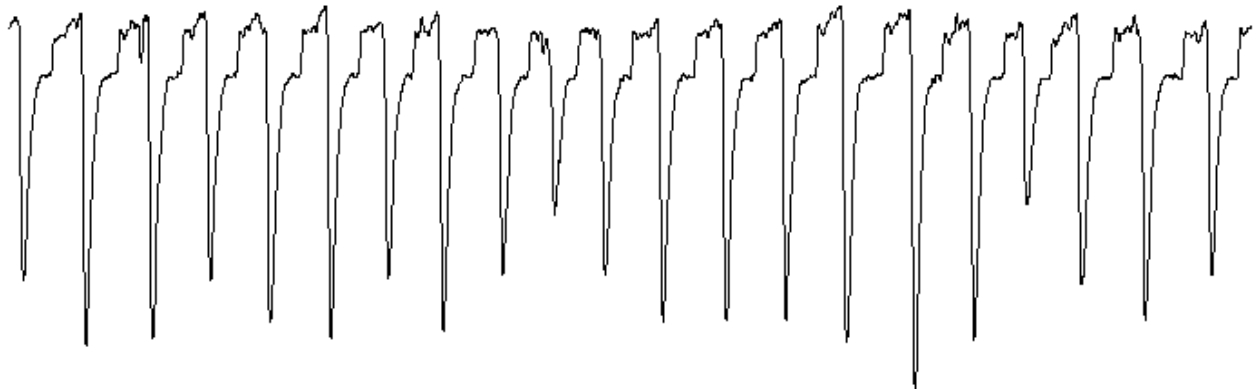


Figure 5: Upper Airway Resistance Syndrome (UARS)

(Flow cut-off or restricted)

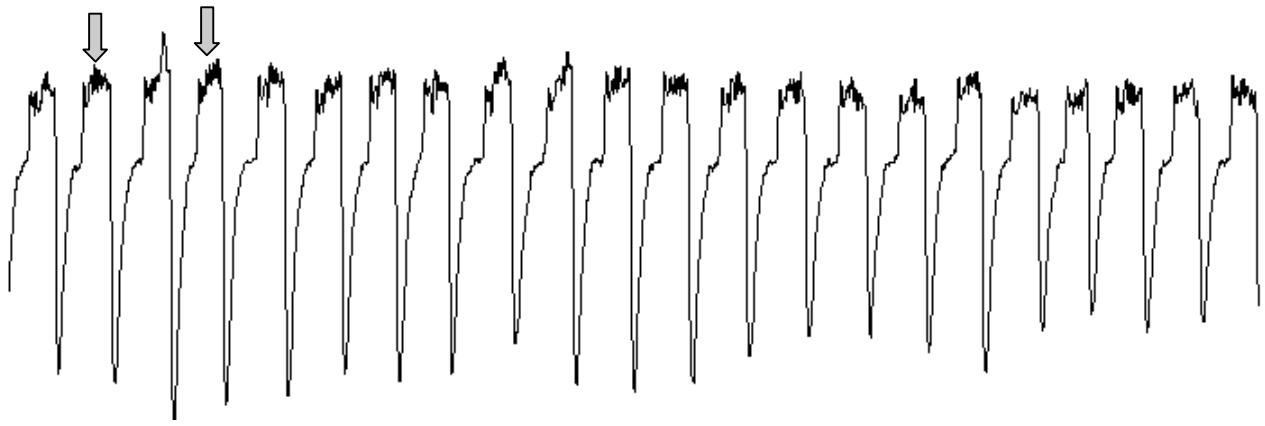


Figure 6: Snoring
(evident in the notched wave peaks)

Report Main Sections

An ApLab Report consists of the following sections:

- 🕒 Summary page
- 🕒 Event listing
 - A sequential listing of all events (automatically & manually determined).
- 🕒 Complete study graphs
 - Breathing graphs (time vs. pressure) of the entire study

Summary Page

This concise summary of the ApLab study is the most common requested by physicians. The contents of the summary page are as follows:

- 🕒 Patient Demographics
 - Name, Address, Date of Birth, Height, Weight
 - Body Mass Index (BMI)
 - Study Date
- 🕒 Provider Information
 - Referring Physician Information
 - Facility Information
- 🕒 RDI Severity Classification & Comments
 - The RDI Severity classifications are automatically generated from event count and effective sleep duration.
 - Normal: RDI ● 5
 - Mild: 5 - 20
 - Moderate 20 - 40
 - Severe RDI ✕ 40
 - The comments section summarizes the findings and may include testing / treatment recommendations.
- 🕒 Summary Results
 - Study Start time & Duration
 - RDI & Calculation time (Effective Study Time)
 - Respiratory Rate
 - Apnea & Hypopnea statistics
 - Total Count
 - Mean
 - Longest
 - Hourly event count table
 - Combined Events summary chart

Figure 7: Summary Report

Event Listing

This section of the report is a detailed listing of all calculated & manually assigned apnea & hypopnea events in the study. It is a chronological event list; displaying the event type, start time and duration of each event. A section of a sample event list is show below.

Event List

Type	Rel Time	Duration	Type	Rel Time	Duration	Type	Rel Time	Duration	Type	Rel Time	Duration
C Ap	00:22:29	13 sec	C Ap	00:47:41	15 sec	C Ap	01:08:26	14 sec	C Ap	01:33:02	23 sec
C Ap	00:23:14	10 sec	C Ap	00:48:07	13 sec	C Ap	01:08:51	14 sec	C Ap	01:33:56	13 sec
C Ap	00:23:34	14 sec	C Ap	00:48:29	12 sec	M Ap	01:09:16	12 sec	C Ap	01:34:23	13 sec

Figure 8: Event List example

Event list legend

Type Designator C = calculated, M = manually assigned, Ap = Apnea, Hyp = Hypopnea
 Rel Time is the time in which the event started *relative* to the study start time
 Duration is the event duration in seconds, starting at time = Rel Time

Complete Study Graphs

This section provides a complete graphical depiction of the patients breathing data. The breathing data is presented in 5-minute graph segments for resolution purposes. A total of 24 pages are required for an average 8 hours study. An example 5-minute segment is shown below.

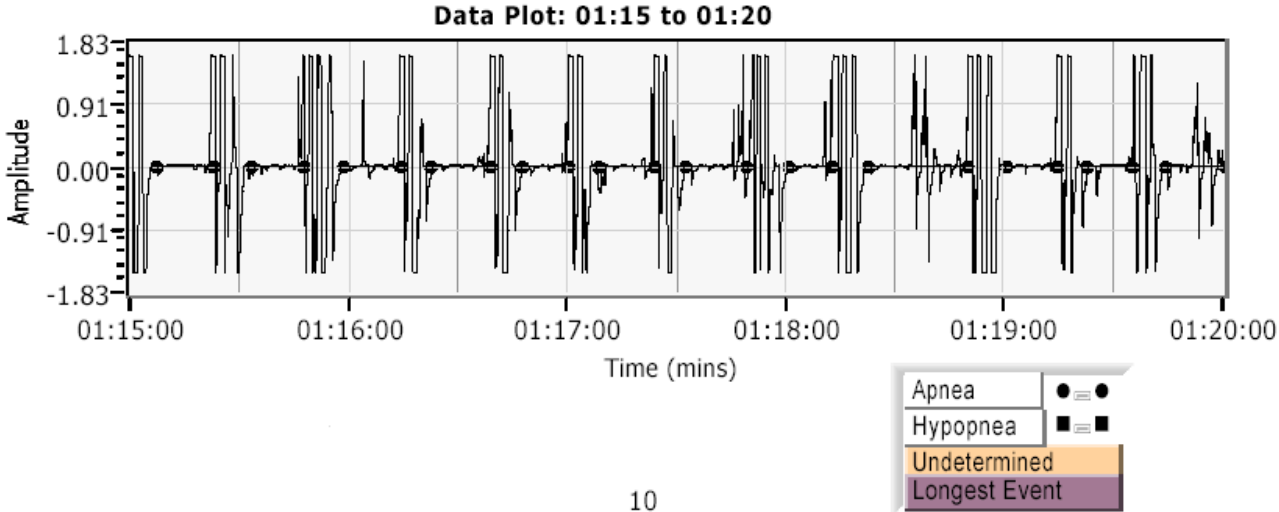


Figure 9: 5 minute graph segments

Understanding the Report

The Study Participant & Provider Info sections of the summary page are self-explanatory.

The Summary Results section is a statistical summation of the study, emphasizing event data. This section allows the physician to quickly review the patients sleep health, particularly in terms of apnea & hypopnea event counts.

The RDI Result section displays the Patients RDI and classifies it into Normal, Mild, Moderate or Severe Obstructive Sleep Apnea. A comments area concisely summarizes the studies statistical data; questionnaire results and provides further treatment recommendations.

Sleep Hygiene

FALLING ASLEEP CAN BE AS EASY AS COUNTING SHEEP

Everyone knows that a good night's sleep makes the difference between feeling good or grumpy the next day; between functioning at peak performance or stumbling sluggishly through the day.

Research tells us that sleep is as vital to our health and well being as a balanced diet or exercising regularly. We spend 1/3 of our lives sleeping; more time than working or playing. This important part of active living restores and prepares our body for daytime alertness and better health. Today's busy life style, late meals, too much coffee, irregular schedules, and unnecessary stress can cause sleep problems. Experts tell us that we need to develop good routine sleep habits. Each person in evaluating his or her own sleep needs should, consider the following:

1. Develop regular sleep habits. Each individual must determine how much sleep he requires at night to be fully alert and energetic during the day.
2. Slow down and unwind before bedtime. Try reading for pleasure, a warm glass of milk, or a relaxing soak in the tub.
3. Get up the same time seven days a week, no matter how well you have slept. This maintains your biological clock and will result in establishing a fairly regular bedtime.
4. Your bedroom should be a comfortable resort for sleeping, ...dark...quiet...cool.
5. Breathe deeply to induce drowsiness. Take a series of three very slow, deep breaths, exhaling fully each time. This helps break tension.
6. Exercise daily to promote good sleep. This releases energy and mental tension. Late evening exercise disturbs peaceful sleep.
7. Accept occasional nights with less sleep. They're a part of life. Although uncomfortable, all of us experience a few nights when sleep is more difficult.
8. When in doubt, get help. If your sleep is still disturbed, ask for help. Contacting a sleep specialist will help determine possible physical factors involved. They also can give you other tips on specific sleep habits you can apply.

Common Sleep Disorders

Snoring

Snoring is the noise produced during sleep by vibrations of the soft tissues at the back of your nose and throat. The noise is created by turbulent flow of air through narrowed air passages. In general and in most cases, snoring has no medical significance unless it keeps you or others from sleeping. However, a more serious problem related to snoring can occur when those same soft tissues block the air passages at the back of the throat while you are sleeping. This interferes with the ability to breathe. This condition is obstructive sleep apnea (OSA), and it can directly affect your health.

Snoring Causes

- ⌚ The prevalence of obstructive sleep apnea increases with age.
- ⌚ In people aged 30-60 years, 2% of all women and 4% of all men have OSA. Up to 60% of the elderly have the condition.
- ⌚ Most people diagnosed with obstructive sleep apnea are obese. Increased neck fat is thought to narrow the airway, making breathing more difficult.
- ⌚ Men are 7-10 times more likely to have obstructive sleep apnea than women.
- ⌚ More African Americans have OSA than do whites.
- ⌚ Most people with obstructive sleep apnea are older than 40 years. Weight gain and a decrease in muscle tone occur with aging, and these may play a role in increasing the incidence of OSA.
- ⌚ Sleep apnea is more common in postmenopausal women.
- ⌚ Family history and genetics play a role.
- ⌚ Polio and muscular dystrophy increase the chance of obstructive sleep apnea, as do other medical conditions such as sinus infections, allergies, colds and nasal tumors, and hypothyroidism (under active thyroid gland).

Many remedies are available over-the-counter in drug stores, but most do not help correct snoring or sleep apnea.

- ⌚ Because you tend to snore more when sleeping on your back, one useful technique is to try to keep from sleeping in that position. One way is to wear a pocket T-shirt backward with a tennis ball in the pocket. You will be less likely to sleep on your back because it is very uncomfortable to sleep on a tennis ball.
- ⌚ Try losing some weight. As little as 10 pounds might make the difference.
- ⌚ Avoid alcohol, especially in the 4 hours before going to sleep.
- ⌚ Avoid using sedatives and narcotic medications. Alcohol, sedatives, and narcotics cause relaxation of your throat muscles and increase the tendency for airway obstruction related to snoring.

Medical Treatment

For mild forms of snoring caused by swelling of the lining of your nose, a doctor may prescribe an inhaled steroid preparation.

For more severe forms of sleep apnea, surgical procedures or continuous positive airway pressure may be tried:

- ⌚ Continuous positive airway pressure (CPAP)
 - ⌚ CPAP is a device that includes a mask that fits snugly over your nose and mouth and is held in place with head straps. The mask is connected to a blower that generates pressurized air. You wear it while sleeping.
 - ⌚ The controlled pressure works as an air splint to keep the soft tissue of the nose and throat in place and the airway open.
 - ⌚ This noninvasive therapy works for 95% of people with sleep apnea.

Surgery- ENT

- ⌚ Somnoplasty: This is an outpatient surgical procedure performed with the patient under local anesthetic. It takes about a half-hour. During the procedure, a small electrode is placed in your anesthetized soft palate and heated up. The heat that is generated by the electrode causes the extra soft tissue at the back of the throat to shrink and contract over a few weeks.
- ⌚ Tonsillectomy and adenoidectomy involves removing the tonsils and adenoids from the back of the throat.
- ⌚ Uvulopalatopharyngoplasty - cutting out certain tissues of the soft palate to remove the obstructing tissue (UPPP).
- ⌚ Laser assisted uvulopalatoplasty - can eliminate or decrease snoring but has not been shown to be effective in the treatment of sleep apnea (LAUP).
- ⌚ Radiofrequency Ablation - treats obstructive sleep apnea, snoring and nasal obstruction in Sleep-Disordered Breathing by shrinking excess tissue in the upper airway

SLEEP APNEA: A BREATHING DISORDER DURING SLEEP

Sleep apnea refers to non-breathing episodes during sleep, occurring as frequently as several hundred times per night. Loud, irregular snoring occurs as the person attempts to breathe at the end of each apneic episode. Although the individual may have had a full night's sleep, he still feels tired the next day.

This surprisingly common sleep disorder is an illness which can progress in severity and become life threatening if not detected and properly treated. Over forty million (40,000,000) Americans suffer from sleep apnea.

Although it seems to be more common in middle-age men and affects 40% of all people over sixty years of age, anyone at any age may develop sleep apnea.

THREE TYPES OF SLEEP APNEA

Obstructive sleep apnea (most common) is caused by an obstruction, which blocks airflow during sleep.

Central sleep apnea is caused by the brain failing to send proper signals to regulate breathing.

Mixed sleep apnea refers to a combination of central and obstructive types.

A routine medical examination cannot reveal the main symptoms of this illness because the patient's respirations remain normal while awake. Proper diagnosis of the severity and type of sleep apnea can only be determined by special monitoring of the individual's sleep.

Sleep apnea can develop into life-threatening health problems. During apneic episodes the oxygen content of the blood decreases, causing the heart to beat irregularly, slow down or stop. Sleep apnea can cause personality changes, morning headaches, hypertension, irregular heart rhythm, impotence and even death.

SYMPTOMS THAT NO AMOUNT OF SLEEP WILL CURE

Very often a person suffering from sleep apnea may not be aware of his loud snoring and breathing irregularities during sleep. The spouse is usually the first to recognize the symptoms and is disturbed during the night by loud snoring or restless movements of the bed partner. The person may only recognize that he is excessively tired during the day, even though he slept through the night. Symptoms while asleep:

- ⌚ Loud irregular snoring, snorting, or gasping for breath
- ⌚ Sudden body movements before the person starts to breathe again
- ⌚ Irregular pounding or beating of the heart when gasping for breath

Symptoms while awake:

- ⌚ Excessive daytime sleepiness, fatigue
- ⌚ Complaints of insomnia or lack of restful sleep
- ⌚ Rapid weight gain sometimes to the point of obesity
- ⌚ Confusion or brief memory loss upon awakening
- ⌚ Unexplained morning headache
- ⌚ High blood pressure
- ⌚ Impotence
- ⌚ Personality changes

TREATMENT

Sleep Apnea can generally be treated very effectively once properly diagnosed and categorized as to type and severity. Treatments for each type of sleep apnea may include:

Obstructive sleep apnea

- ⌚ Weight loss
- ⌚ Surgery to remove airway blockage
- ⌚ The nasal CPAP machine (Continuous Positive Airway Pressure), a device worn over the nose that is attached to an air compressor which keeps airways open.
- ⌚ Dental appliances

Central sleep apnea

- ⌚ Medications, BiPAP, CPAP

Mixed sleep apnea

- ⌚ The same as for obstructive apnea

INSOMNIA: DISRUPTIVE NIGHT TIME SLEEP

Insomnia refers to a persistent difficulty in falling asleep or staying asleep.

It is a symptom (not a cause) of some condition that interferes with one's sleep. Insomnia can result from an interaction of biological, physical, psychological, and environmental factors.

More than 70 million Americans habitually cannot achieve continuous sleep at night. Their sleep can be delayed, disrupted, restless, or limited. To treat insomnia a doctor must find and treat the causes(s).

THREE TYPES OF INSOMNIA

Transient insomnia refers to occasional episodes of restless nights due to environmental changes (i.e. jet lag or noisy construction near one's home) or exciting or anxiety producing experiences (i.e. a fight with the boss or new romance).

Short term insomnia lasting a few weeks, generally arises from temporary stressful experiences (the death of a loved one, the fear of losing a job, or new pressures). Some people have trouble adjusting their sleeping and waking schedule to meet new needs (a change in working hours may affect routine nightly sleep).

Chronic insomnia may last an extended time, months or years. Identifying the causes of these more serious sleep problems may require special testing at a sleep disorders center.

CAUSES OF CHRONIC INSOMNIA

Poor sleep habits, which interrupt or decrease the ability to sleep, keep individuals from obtaining the amount of sleep they need to function.

Psychological problems. Having highly ambitious desires, or demanding peak performance daily can cause persistent anxiety (which can keep people awake). Many try too hard to sleep. Others may experience severe depression, which can profoundly affect sleep and the sleep cycle.

Extended use of sleep medications or drugs (tranquilizers, stimulants, steroids, to name a few) restrict one's deep restful sleep.

Excessive intake of alcohol may act as a sedative for 2-3 hours, then causes disturbed sleep in the latter half of the night.

Disruptive sleeping and waking schedules refer to an irregular bedtime and waking time which confuse our body's biological clock. Some insomniacs take naps to combat excessive daytime sleepiness. With irregular sleep patterns, their sleep becomes dispersed throughout the 24-hour cycle.

The natural process of aging and additional health problems diminish deep restful sleep and the amount of night time sleep to an average of 6 1/2 hours for the elderly.

40% OF CHRONIC INSOMNIA IS CAUSED BY PHYSICAL PROBLEMS

These include:

Sleep Apnea - non-breathing periods during sleep, often occurring several hundred times per night. When a person's breathing stops during sleep he can awaken or go into a lighter stage of sleep. Loud snoring can occur as the person attempts to breathe again.

PLMD or Nocturnal Myoclonus - the periodic involuntary leg movements or jerks during sleep which cause a lighter and less restful sleep.

"Restless Legs" Syndrome - involuntary periodic leg movements or leg cramping while the person is awake, causing leg discomfort and disrupted sleep.

Gastroesophageal Reflux results in gastric (stomach) acid backing into the esophagus disturbing sleep and causing multiple arousals.

Nightmares, Night Terrors, Sleepwalking, and Bed-wetting can also contribute to the subjective complaint of insomnia by causing disruptions within the night of sleep.

How Is Insomnia Treated?

Treatment depends on the cause of insomnia. Non-drug therapy includes using relaxation therapy, controlling stimulation (for example, caffeine ingestion or evening exercise), and limiting time in bed to regular sleep hours. Medications directed toward a specific sleep-disrupting cause should also be considered.

Sedative-hypnotic drugs do not cure insomnia, but they may relieve symptoms. Short-term use (2-3 weeks) of sleeping pills may be warranted for chronic insomnia while other treatments or behavioral therapies are being started.

The choice of sedative-hypnotic depends on the type of sleep problem. If an individual has trouble falling asleep, a quick-acting but short-lasting drug such as zolpidem (Ambien) may be prescribed. These types of drugs are useful because they may be taken after several hours of trying to fall asleep, yet the effects do not last long enough to cause difficulty waking in the morning. Drugs that have longer-lasting actions, such as flurazepam (Dalmane), temazepam (Restoril), estazolam (ProSom), and antidepressants, are useful for individuals who wake up after initially falling asleep.

Benzodiazepine hypnotic drugs: This class of drugs includes estazolam (ProSom), flurazepam (Dalmane), temazepam (Restoril), and triazolam (Halcion).

- 🕒 **How benzodiazepine hypnotic drugs work:** These drugs bind to benzodiazepine receptors (omega-1 and omega-2) in the brain, thereby inducing sleep.
- 🕒 **Who should not use these medications:** People with the following conditions should not use benzodiazepines:
 - Allergy to benzodiazepines
 - Narrow-angle glaucoma
 - Untreated obstructive sleep apnea
 - History of drug abuse
- 🕒 **Use:** Take the prescribed dose 30 minutes before bedtime. Elderly individuals are prescribed smaller doses.

- ⌚ **Drug or food interactions:** Certain drugs, such as cimetidine (Tagamet), azole antifungal medications, antibiotics (for example, erythromycin [E-Mycin, Ery-Tab]), or drugs used to treat AIDS, lessen the body's ability to eliminate benzodiazepines, thereby increasing the risk of toxicity. Some drugs, such as rifampin (Rifadin) or St. John's Wort, may speed the metabolism (breakdown for use in the body) of sedative-hypnotics, thereby decreasing effectiveness.
- ⌚ **Side effects:** Benzodiazepines may impair coordination, balance, or mental alertness and are more likely to disrupt REM sleep, causing less restful sleep.

Nonbenzodiazepine-hypnotic drugs: This class of drugs includes eszopiclone (Lunesta), zaleplon (Sonata), and zolpidem (Ambien).

- ⌚ **How sedative-hypnotic drugs work:** Although these drugs are not chemically like benzodiazepines, they bind to a specific benzodiazepine receptor in the brain called omega-1, thereby inducing sleep. They may be less likely than benzodiazepine medications to disrupt natural sleep rhythm patterns (called the rapid eye movement [REM] ratio). Disruption of REM sleep may make sleep less restful. How Lunesta works is not fully understood. Lunesta is thought to promote sedation and to affect brain receptor sites that are close to gamma-aminobutyric acid (GABA).
- ⌚ **Who should not use these medications:** People with allergy to sedative-hypnotics should not take them.
- ⌚ **Use:** Take the prescribed dose 30 minutes before bedtime. Elderly individuals are prescribed smaller doses.
- ⌚ **Drug or food interactions:** Other drugs that depress the brain, such as alcohol or barbiturates, may increase drowsiness and cause an increased risk of toxicity. Cimetidine (Tagamet) increases Sonata levels, thereby increasing the risk of toxicity. Antidepressant medication can also interact with sedative hypnotic medications. Ketoconazole (Nizoral), itraconazole (Sporanox), clarithromycin (Biaxin), nefazodone (Serzone), ritonavir (Norvir, Kaletra), and nelfinavir (Viracept) may increase blood levels of Lunesta, therefore increasing the risk for side effects.
- ⌚ **Side effects:** Common side effects include drowsiness and dizziness, possibly impairing coordination, balance, and/or mental alertness. These drugs must be used with caution in individuals with a history of drug abuse or dependence. Ambien, Lunesta, and Sonata work very quickly and should only be taken just before going to bed.

Antidepressant drugs: This class of drugs includes but is not limited to the following: amitriptyline (Elavil), nortriptyline (Pamelor), nefazodone (Serzone) and trazodone (Desyrel).

- ⌚ **How antidepressant drugs work:** Some antidepressant drugs cause drowsiness as a side effect. Because this side effect may last for a long time, it can benefit an individual whose problem is awakening after initially falling asleep. Antidepressant drugs may also be used for people who have insomnia caused by depression.
- ⌚ **Who should not use these medications:** Persons taking a monoamine oxidase inhibitor (MAOI, another class of antidepressant drug) should not take these medications. Additionally, anyone with the following conditions should not take antidepressants:
 - ⌚ Allergy to antidepressant drugs

- ⌚ History of seizures
- ⌚ Irregular heart rhythm
- ⌚ Narrow-angle glaucoma
- ⌚ Kidney disease causing retention of urine
- ⌚ **Use:** Take the prescribed dose 30 minutes before bedtime. Elderly individuals are prescribed smaller doses.
- ⌚ **Drug or food interactions:** Do not use within 14 days of taking an MAOI. Other drugs that depress the brain, such as alcohol or barbiturates, may increase drowsiness, cause a hangover effect in the morning, and increase the risk of toxicity. Cimetidine (Tagamet) may increase blood levels of antidepressant drugs, thereby increasing the risk of toxicity.
- ⌚ **Side effects:** Common side effects include dry mouth, blurred vision, constipation, urinary retention, and increased heart rate.

NARCOLEPSY: THE SLEEPING ILLNESS

Narcolepsy is a life-long neurological illness, primarily characterized by sudden uncontrollable sleep attacks and persistent daytime sleepiness.

Narcolepsy affects more than 500,000 Americans and symptoms may arise as early as the onset of puberty and continue throughout life. Recently, scientists have identified a genetic marker for this disease confirming that narcolepsy may be hereditary. A child with a parent having narcolepsy has one chance in twenty of being affected.

Symptoms may vary from mild to totally disabling and may appear suddenly or gradually over a period of years. With narcolepsy, a person's entire lifestyle is dominated by sleep attacks resulting in a constant battle to stay awake. Sudden uncontrollable sleep attacks may occur at any time or during any activity (such as driving, eating, or talking). Concentration and memory recall may be greatly restricted by excessive daytime sleepiness and limited daytime alertness. Secondary psychological problems may become serious causing severe depression for the narcoleptic who feels misunderstood and alone in his sleepy world.

SYMPTOMS THAT NO AMOUNT OF SLEEP WILL CURE

Excessive daytime sleepiness, despite a full night's sleep, may include constant fatigue and dullness of mind.

Uncontrollable sleep attacks, lasting from minutes to hours, may occur suddenly at inappropriate times when others would normally be alert.

Cataplexy (affecting 70% of all narcoleptics) is a sudden loss of muscle tone or muscle weakness usually triggered by extreme emotions such as laughter, anger, fear, elation, or surprise. An attack may range from a brief experience of muscle weakness (sagging of the jaws or buckling of the knees) to profound loss of muscle tone resulting in total body collapse. During the attack, the person remains conscious but is unable to speak or regain physical control for a brief time.

Automatic behavior refers to doing tasks (usually routine in nature) without conscious thinking. Later the person is unable to recall the details of having done a task.

Sleep paralysis refers to the inability to move upon falling asleep or waking up. The person has conscious awareness of not being able to move the body.

Hypnagogic hallucinations are intense, vivid dream-like experiences, which occur between wakefulness and sleep. Hallucinations can involve some or all of the human senses, making it difficult to distinguish from reality. Experiences may be frightening or interesting. Accompanied with sleep paralysis, the individual may experience a terrifying nightmare, but will be unable to "escape" from the frightening object (such as dreaming an intruder is breaking into the house, but being unable to move or call for help).

Polysomnography

For this exam, the patient needs to come to a sleep laboratory about 2 hours prior to bedtime without making any changes in the daily habits. Then, the whole night's sleep is monitored and recorded. The following parameters are monitored:

- ⌚ Electrical activity of the brain (electroencephalogram) C3 - C4, O1 - O2
- ⌚ Electrical activity of the heart (electrocardiogram)
- ⌚ Movements of the chin muscles (electromyogram)
- ⌚ Eye movements (electrooculogram)
- ⌚ Respirations (oral thermistor or nasal pressure transducer)

If a person has narcolepsy, the polysomnograph shows short sleep latency of usually less than 5 minutes and an abnormally short latency prior to the first sleep onset REM sleep (SOREMPs). More than 2 SOREMPs and a mean sleep latency of less than 5 minutes strongly suggest narcolepsy.

Multiple Sleep Latency Test

In this test, the time taken by a person to fall asleep (sleep latency) during the day while lying in a quiet room is measured. This test is performed the morning after the overnight polysomnogram. The person takes 4 or 5 scheduled naps every 2 hours. The first nap starts 2 hours after awakening that morning. People with normal sleep and alertness take about 10-20 minutes to fall asleep. Persons with narcolepsy (and other causes of abnormal sleepiness) take a much shorter time (less than 5 min) to go from wakefulness into sleep.

Two weeks prior to these tests, the patient is asked to keep a sleep diary that record bedtime, wake-up times, and nap times. Their physician will inform them to gradually eliminate medications that could affect the sleep tests.

Medical Treatment

The main focus of medical treatment is symptomatic relief of excessive daytime sleepiness and cataplexy with stimulants of the central nervous system and antidepressants. Stimulants increase wakefulness, vigilance, and performance, while antidepressants reduce cataplectic attacks.

Medications

Drugs that act as stimulants are standard treatments for narcolepsy. They include the following:

- ⌚ Pemoline (Cylert)
- ⌚ Methylphenidate (Ritalin)
- ⌚ Modafinil (Provigil)

Pemoline and methylphenidate

- ⌚ Pemoline and methylphenidate help reduce excessive daytime sleepiness, improving the symptom in 65-85% of patients. Methylphenidate, the most frequently used stimulant, improves alertness in a dose-related fashion.

- ⌚ Unfortunately, these medications have undesirable side effects including headache, irritability, nervousness, and gastrointestinal complaints. Nocturnal sleep may be impaired, thus decreasing sleep time.
- ⌚ There are theoretical concerns that these drugs may become ineffective if used continuously for long periods. Therefore, some health care providers advise people with narcolepsy to abstain from medication 1 day each week (typically on a weekend; drug holiday). During that day, the person should not engage in activities that require being awake, such as driving.
- ⌚ Pemoline has been associated with liver failure in rare cases. Therefore, this medication is not used as first-line therapy and is used only when other therapies have failed.

Modafinil

- ⌚ Modafinil was discovered recently as a novel drug that promotes long-lasting wakefulness.
- ⌚ It has been shown in several trials to reduce excessive daytime sleepiness. People treated with modafinil experienced both subjective improvement and objective improvement in sleepiness.
- ⌚ The most common side effect is headache.
- ⌚ Its safety in children has not been established.

Anticatataplectic agents

- ⌚ Cataplectic attacks are usually treated by clomipramine, imipramine, fluoxetine, or sodium oxybate.
- ⌚ Clomipramine (Anafranil) and imipramine (Tofranil) belong to the family of tricyclic antidepressants. They reduce the frequency of cataplexy in people with narcolepsy.
- ⌚ Fluoxetine (Prozac) is a selective serotonin reuptake inhibitor that is useful in the treatment of cataplexy. It has fewer side effects than tricyclic antidepressants.

Sodium oxybate (Xyrem), commonly called gamma hydroxybutyrate, is a central nervous system depressant used to treat a small subset of people with narcolepsy who have cataplexy whose cataplexy does not respond to the other anticatataplectic medications. The precise mechanism by which it produces an effect on cataplexy is unknown. It has a history of abuse as a recreational drug; therefore, the FDA approved it (in the last couple of years) as a Schedule III Controlled Substance.

Periodic Limb Movement Disorder

Periodic limb movement disorder (PLMD) and restless leg syndrome (RLS) are distinct disorders, but often occur simultaneously. Both PLMD and RLS are also called (nocturnal) myoclonus, which describes frequent or involuntary muscle spasms. Periodic limb movement was formally described first in the 1950s, and, by the 1970s; it was listed as a potential cause of insomnia. In addition to producing similar symptoms, PLMD and RLS are treated similarly.

Periodic Limb Movement Disorder

Periodic limb movement disorder affects people only during sleep. The condition is characterized by behavior ranging from shallow, continual movement of the ankle or toes, to wild and strenuous kicking and flailing of the legs and arms. Furthermore, abdominal, oral, and nasal movement sometimes accompanies PLMD. Movement of the legs is more typical than movement of the arms in cases of PLMD. Movements typically occur for 0.5 to 10 seconds, in intervals separated by five to 90 seconds.

In 1979, the Association of Sleep Disorder Centers (ASDC) set the parameters for determining the presence of PLMD:

- ⌚ A formal diagnosis of nocturnal myoclonus requires three periods during the night, lasting from a few minutes to an hour or more, each containing at least 30 movements followed by partial arousal or awakening. (ASDC 1979)

Today, these parameters are a bit more relaxed, and PLMD usually includes any repetitive, involuntary movement during the night. These limb movements usually occur in deep stage two sleep, but often cause arousal. Thus, PLMD can cause poor sleep, which may lead to sleep maintenance insomnia and/or excessive daytime sleepiness.

The incidence of PLMD increases with age. It is estimated to occur in 5% of people age 30 to 50 and in 44% of people over the age of 65. As many as 12.2% of patients suffering from insomnia and 3.5% of patients suffering from excessive daytime sleepiness may experience PLMD.

Restless Leg Syndrome

Restless leg syndrome was described as early as the 16th century but was not studied until the 1940s. People with RLS complain of an irresistible urge to move their legs while at rest. A person with RLS will experience a vague, uncomfortable feeling while at rest that is only relieved by moving the legs. The symptoms of RLS may be present all day long, making it difficult for an individual to sit motionless. Or they may be present only in the late evening. Late evening symptoms can lead to sleep onset insomnia, which tends to compound the effects of RLS. Pregnancy, uremia, and post-surgery conditions have also been known to increase the incidence of RLS. And, surprisingly, fever seems to decrease it.

Although one study found RLS to be most prevalent in middle-aged females, its incidence increases with age.

Restless leg syndrome is estimated to affect 5% of the population. Approximately 80% of people with RLS have PLMD, though most people with PLMD do not experience RLS.

Medications

Therapy does not cure PLMD but relieves symptoms. Note that many of the medications used to treat PLMD are the same as those used to treat restless legs syndrome.

- ⌚ Benzodiazepines: These drugs suppress muscle contractions. They are also sedatives and help you sleep through the movements. Clonazepam (Klonopin), in particular, has been shown to reduce the total number of periodic limb movements per hour. It is probably the most widely used drug to treat PLMD.
- ⌚ Dopaminergic agents: These drugs increased the levels of an important neurotransmitter (brain chemical) called dopamine, which is important in regulating muscle movements. These medications seem to improve the condition in some people but not in others. Widely used examples are a levodopa/carbidopa combination (Sinemet) and pergolide (Permax).
- ⌚ Anticonvulsant agents: These medications reduce muscle contractions in some people. The most widely used anticonvulsant in PLMD is gabapentin (Neurontin).
- ⌚ GABA agonists: These agents inhibit release of certain neurotransmitters that stimulate muscle contractions. The result is relaxation of contractions. The most widely used of these agents in PLMD is baclofen (Lioresal).

Sleep Disorder Training Test

Please circle the correct answer to the following questions - T or F

1. The Epworth Sleepiness Scale score of 10 > is indicative of an extremely sleepy patient? T / F
2. The AHI index or RDI index is used to determine the severity of sleep disordered breathing? T / F
3. 40% of all chronic insomnias are caused by physical problems. T / F
4. Transient Insomnia may last for an extended time, months or even years? T / F
5. Restless Leg Syndrome (RLS) hallmark symptoms are jerking and kicking legs during sleep with patient complaints of insomnia. T / F
6. The hallmark symptoms of OSA are: Snoring, excessive daytime sleepiness, lack of restful sleep, rapid weight gain, unexplained morning headaches, high blood pressure, impotence, and personality changes? T / F
7. Treatment for OSA includes: Nasal CPAP, upper airway surgery, weight loss? T / F
8. The hallmark symptoms of Narcolepsy are: E.D.S., sleep attacks, cataplexy, sleep paralysis, automatic behavior, hypnagogic hallucination? T / F
9. The diagnostic sleep tests for narcolepsy are the PSG followed by a Multiple Sleep Latency Test(MSLT) T / F
10. The MSLT is a series of 5, 20-minute naps, two hours apart? T / F
11. The hallmark symptoms of PLMD are jerking and kicking arms or legs during sleep, along with patient complaints of insomnia and EDS? T / F
12. An Apnea is defined as a 75% decrease in flow for a least 10 seconds with a corresponding 4% desaturations and/or arousal? T / F
13. A hypopnea is defined as a 30% decrease in flow for at least 10 seconds with a corresponding 4% desaturations and/or arousal? T / F
14. The normal transition of being awake to falling asleep is normally entered through stage REM? T / F
15. REM sleep predominates the last third of the night? T / F
16. NREM and REM sleep cycles alternate within a 30 minute time period T / F
17. Stage 2 sleep generally comprises about 45 to 50 % of sleep? T / F
18. An ApLab RDI score of 40 is indicative of a normal score for OSA? T / F
19. An ApLab RDI score of 10, with an Epworth Sleepiness Score of 15, and symptoms of snoring, EDS, high blood pressure, non-restorative sleep would be indicated for a PSG? T / F
20. An ApLab score of 5, with an Epworth Sleepiness Scale of 16, and symptoms of cataplexy and EDS would be indicated for a PSG and a MSLT? T / F

Name: _____ Date: _____ Score: _____

Other Sleep Disorders

REM movement behavior disorder (RBD)

Patients with REM movement behavior disorder (RBD) act out dramatic and/or violent dreams during rapid eye movement (REM) stage sleep. Another feature of RBD is shouting and grunting. RBD seems similar to other sleep disorders that involve motor activity, like sleepwalking or periodic limb movement disorder. Unlike these conditions, RBD movements occur during REM sleep, which is usually characterized by a state of atonia, or sleep paralysis. Diagnosis and treatment involves polysomnography, drug therapy, and the exclusion of potentially serious neurological disorders.

RBD is usually seen in men 60 years old or older, but also occurs in younger people and in women. Incidents of REM behavior disorder are often described anecdotally to family members and not to physicians, so statistics of incidence are inexact.

Physiology and Causes

Rapid eye movement behavior disorder is an uncommon sleep disorder first described in 1986. There is no known cause for RBD. It is, however, known to occur during rapid eye movement sleep, which is characterized by brain activity patterns that resemble wakefulness and which has been documented with polysomnography and other sleep tests. Most dreaming occurs during REM sleep. Another characteristic of REM sleep is a general state of atonia, or muscle paralysis. So, while the brain is very active during REM sleep, the body is usually still.

Sleep Paralysis

The basic mechanism for REM sleep paralysis is found in the brainstem, the part of the brain that connects the spinal chord to the cerebral hemispheres and that consists of the pons, midbrain, and the medulla oblongata. Though physicians do not thoroughly understand the complex processes, it is known that the brainstem undergoes changes in REM sleep that result in paralysis of the body's voluntary muscles. Certain neurotransmitters, like acetylcholine, become dormant and do not communicate motor activity. The absence of muscular contraction during REM can be seen with polysomnography. The electroencephalogram (EEG) shows elevated brain activity during REM.

Physicians and sleep technicians hypothesize that the brain naturally and purposely prevents motor activity during REM sleep to ensure restful, inactive sleep during the most electrically active stage of sleep. In this context, sleep paralysis describes a normal state of sleep, unlike sleep paralysis experienced in narcolepsy, which affects people while they are trying to stay awake.

Motor Activity and REM Sleep

In RBD, neurotransmitters are not blocked, and the voluntary muscles become tonic, or tensely contracted, allowing a sleeping person to move his or her muscles during REM. Rapid eye movement behavior disorder is characterized by significant submental (under the chin) and limb muscle tone. The combination of heightened cerebral activity and muscular tonicity results in physically acting out dreams that involve excited and sometimes violent movement.

The body can be rigid and extremely tense during episodes of RBD. For example, a person might straighten his or her leg, flexing it intensely for several seconds or a minute. Often, sleepers curl up slightly, while flexing their limbs and chin.

People with RBD typically remember little nothing of this activity, unless they fall out of bed, bump into the furniture, or injure themselves and wake up. But they can usually remember and tell the dreams they were having during an episode.

Dreams that involve physical or violent activity-such as fighting, dancing, running, chasing, attacking, being attacked, running from an assailant-are more likely to trigger RBD activity. Sleepers with RBD sometimes injure their bed partners. Some people have been known to leave the bed, run into a wall, run through a window, or run down the stairs. But RBD activity is usually confined to the bed and the surrounding area.

Medications

Clonazepam (Klonopin) is highly effective in the treatment of REM sleep behavior disorder (RBD), relieving symptoms in nearly 90% of patients with little evidence of tolerance or abuse. The response usually begins within the first week, often on the first night. The initial dose is 0.5 mg at bedtime, with some persons requiring a rapid increase to 1 mg. With continued treatment for years, moderate limb twitching with sleep talking and more complex behaviors can reemerge. The treatment should be continued indefinitely, as violent behaviors and nightmares promptly recur with discontinuation of medications in almost all persons with RBD.

Other medications, such as tricyclic antidepressants, may be effective in some persons with RBD. However, tricyclics are also known to precipitate RBD in some patients.

Parasomnias

Parasomnias are disruptive sleep-related disorders. They are characterized by undesirable physical or verbal behaviors or experiences. Parasomnias occur in association with sleep, specific stages of sleep or sleep-awake transition phases.

Parasomnias may be divided into the following categories:

- ⌚ Primary parasomnias are the disorders of sleep states. They are further classified according to the stage of sleep in which they originate: rapid eye movement (REM) (a stage of sleep in which the eyes move rapidly and dreaming occurs) or non-rapid eye movement (NREM) (stage of sleep in which eye movement does not take place).
- ⌚ Secondary parasomnias are disorders of other organ systems that may manifest during sleep, for example, seizures (convulsions), respiratory dyskinesias (difficulty in performing respiratory movements), arrhythmias (abnormal heart rhythms), and gastroesophageal reflux (food or liquid regurgitating from the stomach into the esophagus).

The 5 disorders that are the most prevalent are nightmare disorder, sleep terror disorder, sleepwalking disorder (somnambulism), REM sleep behavior disorder, restless legs syndrome (RLS), and periodic limb movement disorder (PLMD).

Nightmare disorder

Nightmare disorder is also called dream anxiety attack. Most patients with nightmare disorder are children. Nightmares are frightening dreams that occur during REM sleep and are associated with an increase in heart rate (tachycardia), an increase in the rate of breathing (tachypnea), profuse sweating, and arousal. Most of the time, the patient remembers the scary dream in detail and responds to soothing and comforting by a parent or caregiver.

Sleep terror disorder

Sleep terror disorder is characterized by extreme panic and a sudden, loud, terrified scream during sleep, followed by physical activities such as hitting objects or moving in and out of the bedroom. Persons with this disorder can injure themselves. Sleep terror is a disorder of arousal that primarily occurs during stages III and IV of NREM sleep. Subsequent recollection of the episodes either does not occur or is partial.

Sleepwalking disorder

Patients with sleepwalking disorder show complex automatic behaviors, such as wandering aimlessly, carrying objects without any purpose, going outdoors, and performing other activities of varying complexity and duration (even driving). Persons affected with the disorder usually have their eyes wide open in a stare. They may mumble; however, communication with a person who is sleepwalking is usually poor or impossible. This disorder occurs in the slow-wave stages of NREM sleep.

REM sleep behavior disorder

Patients with REM sleep behavior disorder act out distinctly altered dreams that are vivid, intense, action-packed, and violent. Dream-enacting behaviors include talking, yelling, punching, kicking, sitting, jumping out of bed, arm flailing, and grabbing. An acute form may occur during withdrawal from ethanol or sedative-hypnotic drugs.

Parasomnias (cont)

Restless legs syndrome and periodic limb movement disorder

Restless legs syndrome and periodic limb movement disorder are common disorders that often may coexist. The primary symptom of restless legs syndrome is insomnia (inability to sleep), whereas periodic leg movement disorder is a well-recognized cause of excessive daytime sleepiness. Nearly all persons with restless legs syndrome have periodic limb movements, and only few persons with periodic limb movement disorder also have restless legs syndrome.

Sleepwalking

Sleepwalking, or somnambulism, is a common arousal disorder that is especially prevalent among children. Sleepwalkers (somnambulists) are aroused out of their deep sleep during motor activity, which usually includes, but is not limited to, walking. A sleepwalker can go back to sleep some place other than bed, depending on how far he or she has walked. Sleepwalkers are usually unaware of their activity. Some cases of autonomic (independently functioning) behavior that occur with sleepwalking involve dressing and even eating. What causes sleepwalking is not known, though most people have sleepwalked on at least one occasion. Sleepwalking poses no serious health threat to those who experience it, although the risk of injury, however minor, is a matter of concern. Injury prevention is the primary objective of sleepwalking management.

Sleepwalking is currently being reevaluated in a social and legal context, where the criminal actions of sleepwalkers in certain cases are being judged.

Incidence

Sleepwalking affects approximately 1% to 17% of children and is more frequently seen in boys. The incidence of sleepwalking decreases with age. Although the exact prevalence of sleepwalking in adults is not known, it is estimated to be as high as 10%. The cause for decreased incidence in adults is also not known. Evidence from casework and published sleep diaries indicates that sleepwalkers often feel they are alone with their condition. This is not the case.

Current Research on Sleepwalking

Currently, there is nonspecific medical evidence that suggests that there may be psychiatric issues involved in sleepwalking and that the actions of sleepwalkers in certain cases may not be autonomous and need to be reevaluated.

For example, in Britain, a man actually killed someone while sleepwalking. The issue is whether or not to acquit the defendant on the basis of autonomic actions or to find him insane and, therefore, release him to treatment for mental illness. Subsequently, there is controversy surrounding an individual's right to plead insanity in cases like this, which complicates our perspective of agency in sleepwalking behavior. Sleepwalking is not currently defined or treated as a mental illness.

Future research may involve the development of a medical-legal definition of sleepwalking. Of course, cases like this are rare, but the media coverage of it is greatly responsible for public recognition of sleepwalking.

Bruxism

Bruxism is when you clench or grind your teeth. The term clenching means you tightly clamp your top and bottom teeth together, especially the back teeth. The stressful force of clenching causes pressure on the muscles, tissues, and other structures around your jaw. This can lead to jaw joint disorders, jaw pain and soreness, headaches, earaches, damaged teeth, and other problems. These symptoms are often collectively referred to as "TMJ".

Many people who clench also grind their teeth. Grinding is when you slide your teeth over each other, generally in a sideways, back-and-forth movement. This action may wear down your teeth and be noisy enough at night to bother sleeping partners. Like clenching, grinding can lead to jaw pain and other problems.

Causes, incidence, and risk factors

People can clench and grind subconsciously during both the day and night, although sleep-related bruxism is often the bigger problem because it is harder to control.

The cause of bruxism is not completely agreed upon, but daily stress may be the trigger in many people. Some people probably clench and never feel symptoms. Whether or not bruxism causes pain and other problems may be a complicated mix of factors -- how much stress you are under, how long and tightly you clench and grind, whether your teeth are misaligned, your posture, ability to relax, diet, sleeping habits, and other factors. Each person is probably different.

Symptoms

- ⌚ Teeth grinding, which may be loud enough to annoy sleeping partners
- ⌚ Sore or painful jaw
- ⌚ Headache
- ⌚ Earache (partly because the structures of the temporomandibular joint are very close to the ear canal, and partly because of referred muscle pain -- pain that is perceived in a location different from its actual source)
- ⌚ Anxiety, stress, and tension
- ⌚ Insomnia, depression, eating disorders

Signs and tests

An examination can rule out other disorders that may cause similar jaw pain or ear pain, including ear disorders such as ear infections, problems with the temporomandibular joint (TMJ) itself, and dental disorders. The person may have a history of significant stress and tension.

Treatment

The goals of treatment are to reduce pain, prevent permanent damage to the teeth, and reduce clenching behaviors as much as possible.

To help relieve pain, there are many self-care steps you can take at home. For example:

- ⌚ Relax your facial and jaw muscles throughout the day. The goal is to make facial relaxation a habit.
- ⌚ Massage the muscles of the neck, shoulders, and face. Search carefully for small, painful nodules called trigger points that can refer pain throughout the head and face.
- ⌚ Learn physical therapy stretching exercises to help the restore a normal balance to the action of the muscles and joint on each side of the head.
- ⌚ Apply ice or wet heat to sore jaw muscles. Either can have a beneficial effect.
- ⌚ Avoid eating hard foods like nuts, candies, and steak.
- ⌚ Drink plenty of water every day.
- ⌚ Try to reduce your daily stress and learn relaxation techniques.
- ⌚ Get plenty of sleep.

To prevent damage to the teeth, mouth guards or appliances (splints) have been used since the 1930's to treat teeth grinding, clenching, and TMJ disorders. A splint may help protect the teeth from the pressure of clenching. It may also actually help reduce clenching behaviors, but some people find that it makes their clenching worse. In others, the symptoms go away as long as they use the splint, but pain returns when they stop or the splint loses its effectiveness over time.

There are many different types of splints. Some fit over the top of the teeth, some on the bottom. They may be designed to keep your jaw in a more relaxed position or provide some other function. If one type doesn't work, another may.

As a next phase after splint therapy, orthodontic adjustment of the bite pattern may be beneficial for some people. Surgery should be considered a last resort.

Finally, there have been numerous approaches to try to help people unlearn their clenching behaviors. These are more successful for daytime clenching, since nighttime clenching is cannot be consciously stopped. In some people, just relaxing and modifying daytime behavior is enough to reduce nighttime bruxism. Methods to directly modify nighttime clenching have not been well studied. They include various biofeedback devices, self-hypnosis, and other alternative therapies.

Jet Lag

Jet lag, or desynchronization, is a temporary condition that some people experience following air travel across several time zones in a short period of time. This causes the traveler's internal clock to be out of sync with the external environment. People experiencing jet lag have a difficult time maintaining their internal, routine sleep-wake pattern in their new location, because external stimuli, like sunshine and local timetables, dictate a different pattern. For this reason, one can feel lethargic one moment and excited the next. Jet lag creates a double bind for vacationers and business people who must cross several time zones to reach their destination, but who are also intent on maximizing sightseeing or productivity. As travelers attempt to adjust their internal clock to a new external environment, symptoms result with varying intensity.

Jet lag (desynchronization) occurs while rapidly crossing time zones, or, more specifically, it occurs after crossing the Earth's meridians. Meridians demarcate geographic position in relation to the Earth's poles and, ultimately, define time zones. Jet lag is a unique sleep disorder because its onset is not necessarily caused by abnormal sleep patterns, like insomnia. Travelers who sleep normally prior to transmeridian travel are not immune to jet lag; the symptoms result when a person's internal clock attempts to acclimate to a new external environment. This acclimation involves circadian rhythms that, among other functions, are associated with the body's management of sleep.

Symptoms

In addition to the "tired-wired," "soar-crash" feeling that travelers experience after long, rapid air travel, there are numerous symptoms that may occur with jet lag, such as insomnia, daytime fatigue, stomachaches, headaches, irritability, and decreased awareness. The degree of disruption varies greatly among people; some may not be bothered at all. Jet lag is a transient sleep disorder and is classified differently than other, more serious disorders. Although jet lag occasionally lasts for a week or more, travelers usually return to their normal sleep-wake pattern after a day or two. For many travelers, jet lag can catalyze the effects of certain conditions associated with the head and nervous system that are not related to specific sleep-wake patterns. For example, many symptoms attributed to jet lag are actually caused by the environment of the airplane--dry air (humidity in an airplane is very low), pressurization, noise, vibrations, and a cramped environment. These symptoms may include dry eyes, dry and irritated nose and sinuses, headaches, earaches, muscle cramps, and abdominal distention (bloating). Occasionally, dizziness or swollen feet and ankles may

Circadian Rhythms

Circadian rhythms pertain to changes in body function that occur throughout a 24-hour period. Circa is the Latin word for "about," and diem is the Latin word for "day." The body operates with many circadian rhythms, such as body temperature regulation, endocrine (gland and hormone) function, airway function, and kidney (renal) function.

For instance, body temperature slowly rises throughout the day, drops dramatically around midnight, and begins to rise again before 6 a.m. These changes in temperature are often felt during fever, when fluctuations are intensified by high body temperature. The body also regulates breathing patterns. So patients with asthma often have more bronchoconstriction and more difficulty with their asthma during the night when airway function fluctuates to compensate for sleep.

Mental alertness and the propensity to fall asleep are regulated by circadian rhythm. There are two peak times of day at which a person is most susceptible to falling asleep, 3 a.m. to 5 a.m. and 3 p.m. to 5 p.m. This circadian tendency has serious ramifications in our society. There are a disproportionate number of automobile accidents between 3 a.m. and 5 a.m. compared to the number of people on the road at these times. This increase in automobile accidents is partly attributable to conflicts between circadian rhythms and, for instance, atypical lifestyle or shift work constraints that put drivers on the road at these times.

Decreased vigilance can combine with sleepiness and result in an accident. Apparently, circadian rhythms are evident in all types of activity.

Most people have experienced the urge to fall asleep in the late afternoon, after eating lunch. It is not necessarily the food that makes people want to fall asleep at this time, but the time of day. Again, the routines of environment conflict with circadian rhythms, which can influence one's ability to function.

All the rhythms mentioned above occur in humans within a cycle of approximately 24 hours. The exact length of the cycle is not known and is probably slightly longer than 24 hours, perhaps 24.7 to 25 hours. These natural rhythms occur even in the absence of daylight or darkness. Studies in which people live without any way of knowing what time of day it is have shown that these people continue to follow a 24-hour schedule. That is, they sleep for about eight hours, and their waking activity levels correlate with those found for individuals under normal conditions of time and light-dark cycles. It seems the influence of circadian rhythm is unavoidable.

People naturally synchronize their internal clocks with day-night cycles, which allows them to be awake during the day and to sleep during the night. The body regulates this chiefly through the eyes. Light stimulates nerves in the retina that pass a signal through a chain of nerves to the brain. Some of these nerves feed the hypothalamus, a part of the brain that regulates body temperature, water and sugar ratios, and fluid secretions and which houses the suprachiasmatic nucleus, a bundle of nerves that controls the body's circadian rhythms. When, for example, bright light stimulates the optic nerves, the optic nerves send the signal to the suprachiasmatic nucleus, which then triggers circadian rhythms, resulting in the synchronization of the body's 24-hour cycle with the earth's 24 hour cycle.

Shift work

Nowhere are the effects of lifestyle on sleep more evident than in shift work change (SWC), also called shift lag. As the global marketplace continues to turn the time-to-productivity ratio to its favor, more and more employees are needed to work unconventional shifts. Nearly 20% of employees in industrialized countries are employed in shift work, which requires them to drastically change their sleep habits weekly or even daily.

While there are no statistics for the prevalence of SWC effects, approximately 20% of shift workers report falling asleep during work, which increases the risk of industrial accidents and decreases productivity. Ironically, shift work can diminish the economic gain it is designed to create.

Causes

There are two types of shift work. Employees either (1) work an unconventional nonfluctuating shift, like 11 p.m. to 7 a.m., or (2) alternate between the three different shifts. Both versions produce their own set of effects.

A person can usually adjust to working a new shift, if the change is permanent. Although the worker may have to get used to sleeping during daylight, circadian rhythm can adjust to the body's new sleep-wake routine. It is common for a person who sleeps from 8 a.m. to 4 p.m. consistently to function productively at work from 11 p.m. to 7 a.m. Circadian rhythms operate on a 24-hour cycle. In nonfluctuating shift work, the shift in circadian rhythm remains constant once the body adapts to it. Resynchronization may take a while, but it is possible.

Shift work change affects circadian rhythm, which, similar to delayed sleep phase syndrome and jet lag, desynchronizes the body's sleep-wake schedule. This happens when shift workers toggle between the three common shifts, each one-third of the 24-hour day. The first shift usually runs from 7 a.m. to 3 p.m.; the evening or second shift generally lasts from 3 p.m. to 11 p.m.; and the night shift is usually from 11 p.m. to 7 a.m. Many shift workers frequently change shifts, thus intensifying the severity of circadian rhythm disturbance.

The body simply cannot rest and rebuild when circadian rhythms are frequently disrupted. Sleep-wake routines vary with continually changing external cues, known in the sleep medicine world as "zeitgebers," the German word for "timer." In SWC, zeitgebers such as daytime and nighttime are never permanently synchronized with shift end time and shift start time. For SWC patients, predisposition to sleep and wake is governed by consistently mistimed circadian rhythm and alternating external cues. For example, a person may work the night shift for five nights in a row, followed by two days off. During the two days off, the person resumes a normal daytime (diurnal) activity with family or friends. This disrupts the person's previously adjusted circadian rhythm, and he or she must readjust their sleep-wake pattern when they go back to work. Without a constant pattern, biological rhythms remain out of synch.

Delayed sleep phase syndrome (DSPS)

Delayed sleep phase syndrome (DSPS), also called phase lag syndrome, is a circadian rhythm sleep disorder. However, unlike jet lag and the effects of shift work, delayed sleep phase syndrome is a persistent condition. In clinical settings, it is one of the most common complications of sleep-wake patterns.

Delayed sleep phase syndrome results from a desynchronization between the patient's internal biological clock and the external environment. Unlike jet lag, this desynchronization is not activated by travel or change in external environment. Rather, the patient's propensity to fall asleep is simply "delayed" in relation to that of the general public. Subsequently, a patient with DSPS is desynchronized with the routine that governs most of his or her life.

Patients typically are unable to fall asleep before 2 a.m. and have extreme difficulty waking early (e.g., by 7 a.m.). People with DSPS are sometimes called "night owls" or are described as "not being morning people." If they are able to sleep a full 7 to 8 hours (e.g., until 10 a.m.), they feel rested and function normally. Unfortunately, this is usually not the case.

The main difficulty for patients with DSPS is functioning early in the morning for school or work. A person with DSPS often fails courses in school or loses jobs, affecting them socially and compromising their health.

Patients with DSPS may initially refer to their symptoms as insomnia. As soon as people deviate from a normal sleep pattern, they tend to assume that they are not capable of sleep at all, but this is not true. Patients with DSPS are able to get plentiful sleep; it just differs from traditional sleep-wake patterns. DSPS makes it hard to wake up in the morning when simultaneously indulging in a late night sleep routine.

Incidence and Prevalence

Incidence of delayed sleep phase syndrome is unknown. In a recent study involving 5,000 participants, DSPS accounted for about 40% of disorders involving sleep-wake schedules. DSPS may surface in childhood and it occurs most often in young men. It is estimated that the disorder affects approximately 7% of teenagers



ApLab[®] Patient Information Record

Please complete all information **to aid your physician in evaluating your Sleep Study.**

Last Name _____ First Name _____ M.I. _____

Address _____ City _____ State _____ Zip _____

Phone (H) _____ (W) _____ Ht. _____ Wt. _____

Social Security # _____ D.O.B. ____ \ ____ \ ____ Age ____ Gender M/ F

Referring Physician _____ Phone Number (____) _____ - _____

Address _____ City _____ State _____ Zip _____

Please answer the following questions before and after your ApLab[®] screening test.

Study Date ____ \ ____ \ ____ Start Time: _____ PM/AM

How long did it take for you to fall asleep? _____ (minutes)

How many times did you awaken last night? _____ (# times)

Of the time spent in bed last night, what proportion do you estimate you spent on your back? _____ side? _____ stomach? _____ Be sure that these total 100%

What time did you remove the ApLab[®] tubing from your nose? _____ PM/AM

Did you use the adhesive tape supplied? Y/ N Did the tape stay in place? Y/ N

Comments: _____

Epworth Sleepiness Scale

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?

Use the following scale to choose the most appropriate number for each situation:

0 = no chance of dozing 1 = slight chance of dozing 2 = moderate chance of dozing 3 = high chance of dozing

Situation	Chance of Dozing
Sitting and Reading	_____
Watching TV	_____
Sitting inactive in a public place (e.g. a theater or a meeting)	_____
As a passenger in a car for an hour without a break	_____
Lying down to rest in the afternoon when circumstances permit	_____
Sitting and talking to someone	_____
Sitting quietly after lunch without alcohol	_____
In a car, while stopped for a few minutes in traffic	_____
Total score	_____

If your score is greater than 6 points, then you are **sleepy**. If your score is 10 or more points, you are **very sleepy**. If your score is more than 16 points you are **dangerously sleepy**.

Please check off all questions that apply to you to the best of your knowledge; you may need to ask your bed partner for help with these questions.

1 I have been told that I snore.

2. I have been told that I hold my breath when I sleep.

- 3. I have high blood pressure.
- 4. My friends and family say that I'm grumpy and irritable.
- 5. I wish I had more energy.
- 6. I sweat excessively during the night.
- 7. I have noticed my heart pounding or beating irregularly during the night.
- 8. I get morning headaches.
- 9. I suddenly wake gasping for breath.
- 10. I am overweight.
- 11. I seem to be losing my sex drive.
- 12. I often feel sleepy and struggle to remain alert.
- 13. I frequently wake with a dry mouth.
- 14. I have difficulty falling asleep.
- 15. Thoughts race through my mind and prevent me from sleeping.
- 16. I anticipate a problem with sleep several times a week.
- 17. I wake up and cannot go back to sleep.
- 18. I worry about things and have trouble relaxing.
- 19. I wake up earlier in the morning than I would like to.
- 20. I lie awake for half an hour or more before I fall asleep.
- 21. I often feel sad and depressed.
- 22. I have trouble concentrating at work or school.
- 23. When I am angry or surprised, I feel like my muscles are going limp.
- 24. I have fallen asleep while driving.
- 25. I often feel like I am in a daze.
- 26. I have experienced vivid dreamlike scenes upon falling asleep or awakening.
- 27. I have fallen asleep in social settings such as the movies or at a party.
- 28. I have trouble at work because of sleepiness.
- 29. I have dreams soon after falling asleep or during naps.
- 30. I have "sleep attacks" during the day no matter how hard I try to stay awake.
- 31. I have had episodes of feeling paralyzed during my sleep.
- 32. I wake up at night with an acid/sour taste in my mouth.
- 33. I wake up at night coughing or wheezing.
- 34. I have frequent sore throats.
- 35. During the night I suddenly wake up feeling like I am choking.
- 36. Other than when exercising, I experience muscle tension in my legs.
- 37. I have noticed (or others have commented) that parts of my body jerk during sleep.
- 38. I have been told that I kick at night.
- 39. When trying to go to sleep, I experience an aching or crawling sensation in my legs.
- 40. I experience leg pain or cramps at night.
- 41. Sometimes I can't keep my legs still at night; I just have to move them to feel comfortable.
- 42. Even though I slept during the night, I feel sleepy during the day.

1-13 _____ 14-21 _____ 22-31 _____ 32-35 _____ 36-42 _____ Total Score _____

Scoring

Questions 1-13: If you marked three or more boxes, you show symptoms of **Sleep Apnea** – a potentially serious disorder that causes you to stop breathing repeatedly, often hundreds of times in the night during your sleep.

Questions 14-21: If you marked three or more boxes, you show symptoms of **Insomnia** – a persistent inability to fall asleep or stay asleep.

Questions 22-31: If you marked three or more boxes, you show symptoms of **Narcolepsy** – a life-long disorder characterized by uncontrollable sleep attacks during the day.

Questions 32-35: If you marked two or more boxes, you show symptoms of **Gastroesophageal Reflux**- a disorder caused by acid "backing up" into the esophagus during sleep.

Questions 36-42: If you marked three or more boxes, you show symptoms of **Periodic Limb Movement Disorder**- uncontrollable leg or arm jerks during sleep or **Restless Leg Syndrome** – uncomfortable feelings in the legs at night.

This sleep questionnaire will help your physician to better understand your sleep problems.

Glossary

Abdominal Movement - In diagnostic sleep studies, abdominal movement is recorded. This is one of the measures of respiratory effort, reflecting movement of the diaphragm.

Advanced Sleep Phase Syndrome (ASPS) - Phases of the daily sleep/wake cycle are advanced with respect to clock time. This is classified as a circadian rhythm disorder. The sleep phase occurs well ahead of the conventional bedtime and the tendency is to wake up too early.

Apnea - airflow is decreased by 75% for 10 seconds or more with a corresponding 4% or greater desaturation and/or arousal.

Apnea index (AI) - A measure of the severity of sleep apnea; the number of apnea events per hour.

Apnea/Hypopnea index (AHI) - the number of apneas and hypopneas per hour. 5-20=mild, 21-40=moderate, above 40 severe

Arousal - abrupt change from sleep to wakefulness, or from a "deeper" stage of non-REM sleep to a "lighter" stage

Arousal Disorder - parasomnia disorder presumed to be due to an abnormal arousal function. Classical arousal disorders: sleepwalking, sleep terrors and confusional arousals.

Auto Adjusting Continuous Positive Airway Pressure Device (SmartPAP) (Auto-PAP) - A type of CPAP machine monitoring changes in breathing and compensates automatically by making appropriate adjustments in pressure.

Basic Sleep Cycle - progression through orderly succession of sleep states and stages. For the healthy adult, the first cycle begins by going from wakefulness to non-REM sleep. The first REM period follows the first period of non-REM sleep, and the two sleep states continue to alternate throughout the night with an average period of about 90 minutes. A night of normal human sleep usually consists of 4-6 non-REM/REM sleep cycles.

Benzodiazepines - developed in the 1950's, this class of compounds tranquilize and sedates.

Bi-Level - Bi-level pressure device used to treat sleep apnea. The "bi" refers to two pressures: a lower pressure for exhalation and a higher pressure for inhalation. Bi-Level machines are more expensive than a standard CPAP, but some patients tolerate it better because they can exhale comfortably against the constant inhalation pressure. (Sometimes called **Bi-PAP**, but that is a trademark name of one system)

Body Position - four positions are identified which a patient may be sleeping; back, left side, right side or abdomen. The time spent sleeping in each position and the number of respiratory events in a particular position are tabulated. .

Brain Waves – the brain's spontaneous electrical activity studied by electroencephalography (EEG).

Bruxism – teeth grinding during sleep

Cataplexy - sudden, dramatic decrement in muscle tone and loss of deep reflexes that leads to muscle weakness, paralysis, or postural collapse. Usually caused by outburst of emotion: laughter, startle, or sudden physical exercise; one of the tetrad of symptoms of narcolepsy.

Central Alveolar Hypoventilation Syndrome - is characterized by ventilatory impairment, resulting in arterial oxygen desaturation that is worsened by sleep, which occurs in patients with normal mechanical properties of the lung.

Central apnea - absence of airflow and inspiratory effort; apnea caused by irregularity in the brain's control of breathing.

Cheyne-Stokes respiration - breathing pattern typified by regular "crescendo-decrescendo" or waxing and waning fluctuations in respiratory rate and tidal volume.

Chronotherapy - treatment for circadian rhythm sleep disorder by systemically changing sleeping and waking times to reset the biological clock.

Circadian rhythm - innate, daily, fluctuation of behavioral and physiological functions, including sleep waking, generally tied to the 24-hour day-night cycle but sometimes to a different (e.g., 23 or 25 hour) periodicity when light/dark and other time cues are removed.

Compliance - adhering to or conforming with a regimen of treatment such as CPAP

CPAP - Continuous Positive Airway Pressure; the device used to treat sleep apnea by sending positive airway pressure at a constant, continuous pressure to help keep an open airway, allowing the patient to breathe normally through his/her nose and airway

CPAP Pressure - pressure needed to maintain an open airway in a sleep apnea patient treated with CPAP, expressed in centimeters of water (cm H₂O). The positive pressure can range from 5 - 20 cm H₂O. Different patients require different pressures. The value is determined in a CPAP titration study.

Deep Sleep - refers to combined non-REM sleep stages 3 and 4 in sleep studies

Delayed sleep phase - A condition occurring when the clock hour at which sleep normally occurs is moved back in time in a given, 24 hour sleep-wake cycle. The result is a temporarily displaced (delayed) occurrence of sleep within the 24-hour cycle.

Delta sleep - stage(s) of sleep in which EEG delta waves are prevalent or predominant (sleep stages 3 and 4, respectively).

Delta waves - EEG activity with a frequency less than 4 Hz. In human sleep stage scoring, conventionally the minimum criteria for scoring delta waves is 75 uV (peak-to-peak) amplitude, and 0.5 second duration (2 Hz).

Diagnostic Sleep Study - monitoring of several physiological activities in a sleeping individual. Usually performed to determine the absence or presence of a specific sleep disorder. The sleep study can occur in a sleep disorders center or in a patient's home with portable recording equipment.

Diaphragm - large, concave muscle attached to the rib cage at bottom of the chest (top of the abdomen)

DME - Durable Medical Equipment. Equipment such as wheelchairs and walkers which are prescribed for use by or on the order of a physician, also includes CPAP and Bi-Level machines.

Drowsiness, Drowsy - quiet wakefulness occurring prior to sleep onset.

Dyssomnia - a disorder of sleep or wakefulness; not a parasomnia

Electrocardiography (EKG) – a method of measuring the electrical activity of the heart.

Electroencephalogram (EEG) - recording through the scalp of electrical potentials from the brain and the changes in these potentials. The EEG is one of the three basic variables (along with the EOG & EMG) used to score sleep stages and waking. Surface electrodes are used to record sleep in humans, recording potential differences between brain regions and a neutral reference point, or between brain regions.

Electromyogram (EMG) - recording of electrical activity from the muscular system; in sleep recording, synonymous with resting muscle activity or potential. The chin EMG, along with EEG and EOG, is one of the three basic variables used to score sleep stages and waking. Surface electrodes are used to record sleep in humans, measuring activity from the submental or masseter muscles. These reflect the changes in resting muscle activity. During REM sleep the chin/cheek EMG is tonically inhibited.

Electro-oculogram (EOG) - recording of voltage changes resulting from shifts in position of the eyeball-possible because each globe is a positive (anterior) and negative (posterior) dipole; along with the EEG and the EMG, one of the three basic variables used to score sleep stages and waking. Human sleep recordings utilize surface electrodes placed near the eyes to record the movement of the eyeballs. Rapid eye movements in sleep indicate a certain stage of sleep (usually REM sleep).

ENT - Ear, Nose and Throat. A doctor specializing in diseases of the Ear, Nose and Throat. These specialists often do surgery as well, and may be referred to as an ENT surgeon.

EPAP - Expiratory Positive Airway Pressure. Pressure prescribed for the expiratory (breathing out) phase of an individual on Bi-level CPAP therapy for OSA (obstructive sleep apnea).

Epoch - A standard 30-second duration of the sleep recording that is assigned a sleep stage designation; for special purposes, occasionally longer or shorter epochs are scored.

Epworth Sleepiness Scale - index of sleep propensity during the day as perceived by patients, and derived from the answers to 8 questions.

Excessive daytime sleepiness or somnolence (EDS) - subjective report of difficulty in staying awake, accompanied by a ready entrance into sleep when the individual is sedentary

Flow Limitation – the partial closure of the upper airway impeding the flow of air into the lungs.

Fragmentation (pertaining to Sleep Architecture) - interruption of a sleep stage as a result of the appearance of a lighter stage, or to the occurrence of wakefulness, which leads to disrupted non-REM-REM sleep cycles.

GABA (Gamma-Aminobutyric Acid) - major neurotransmitter in the brain, which is considered to be involved in muscle relaxation, sleep, diminished emotional reaction and sedation.

Gastroesophageal Reflux Disease (GERD) - flow of stomach acid upwards into the esophagus that can cause arousals and disrupt sleep.

Hypersomnia – excessive, prolonged sleep

Hypopnea - airflow is decreased by 30% for 10 seconds or more with a corresponding 4% or greater desaturation and/or arousal.

Imidazopyridines - New class of compounds inducing sleepiness. (Zolpidem, trade name Ambien, is in this class).

Insomnia – complaint describing difficulty in sleeping

Inspiratory Phase - part of the breathing cycle in which air is inhaled.

IPAP - Inspiratory Positive Airway Pressure. Physician prescribed pressure for the inspiratory phase on a Bi-level CPAP device, used in the treatment of OSA.

Jet Lag - disturbance induced by a major rapid shift in environmental time during travel to a new time zone

Leg Movement - Leg movements are recorded in both diagnostic sleep studies and titration studies.

Light Sleep - term used to describe non-REM sleep stage 1, and sometimes, stage 2.

Mixed (sleep) apnea - interruption in breathing during sleep beginning as a central apnea then becoming an obstructive apnea.

Motor Atonia – the absence of muscle activity during sleep

Multiple sleep latency test (MSLT) - a series “nap tests” utilized in the assessment of excessive daytime sleepiness.

Muscle Tone – amount of tension in a muscle.

Narcolepsy - sleep disorder characterized by excessive sleepiness, cataplexy, sleep paralysis, hypnagogic hallucinations, and an abnormal tendency to pass directly from wakefulness into REM sleep

Nasal Airflow/Nasal Ventilation - recording of the complete respiratory cycle by measuring inspiratory and expiratory airflow

Nightmare - unpleasant and/or frightening dream occurring in REM sleep (different from a night terror)

Night Terrors - also known as sleep terrors, or pavor nocturnus. Night terrors are characterized by an incomplete arousal from slow wave sleep. If, the individual is awakened during a night terror, he/she is usually confused and does not remember details of the event. Night terrors are different from nightmares; if an individual is awakened

NREM or non-REM sleep - characterized by slower and larger brain waves and little or no dream behavior; quiet sleep, slow-wave sleep; approximately 80% of sleep

NREM Sleep Intrusion - brief period of NREM sleep patterns appearing in REM sleep; a portion of NREM sleep not appearing in its usual sleep cycle position

Obstructive apnea - cessation of airflow (at least 10 seconds) in the presence of continued inspiratory effort; cessation of breathing during sleep, due to a mechanical obstruction, such as a semi-collapsed trachea, tongue relaxed to back of the throat, or a large amount of tissue in the uvula area.

Obstructive Hypopnea - periodic and partial closure of the throat during sleep resulting in reduced air exchange at the level of the mouth and/or nostril.

Oxygen Desaturation - less than normal amount of oxygen carried by hemoglobin in the blood; values below 90% are considered abnormal

Oxygen Saturation - measure of oxygen carried by hemoglobin in the blood. Normal values 90% - 100%.

O₂ - Chemical symbol for oxygen. Criterion lowest percent O₂ saturation: Greater than 85%=mild, 80% to 85%=moderate, less than 80%=severe

Parasomnia - an event happening during sleep, or induced or exacerbated by sleep, such as sleepwalking or asthma; not a dyssomnia.

Pavor Nocturnus (Night Terrors) - See Night Terrors.

Periodic Breathing - repetitive apneic pauses, common in premature infants.

Periodic Limb Movement Disorder - also known as periodic leg movements and nocturnal myoclonus. Characterized by periodic episodes of repetitive and highly stereotyped limb movements occurring during sleep. The movements are often associated with a partial arousal or awakening; however, the patient is usually unaware of the limb movements or frequent sleep disruption. Between the episodes, the legs are still. There can be marked night-to-night variability in the number of movements or in the existence of movements.

Persistent Insomnia - continuing insomnia responding poorly to treatment.

Pickwickian Syndrome - obesity accompanied by somnolence, lethargy, chronic hypoventilation, hypoxia, and secondary polycythemia (a condition marked by an abnormal increase in the number of circulating red blood cells); usually has severe obstructive sleep apnea

PLMD-Arousal Index - number of sleep-related periodic leg movements per hour of sleep that are associated with an EEG arousal

Polysomnogram (PSG) - continuous and simultaneous recording of physiological variables during sleep, i.e., EEG, EOG, EMG (the three basic stage scoring parameters), EKG, respiratory air flow, respiratory excursion, lower limb movement, and other electrophysiological variables.

Polysomnograph - biomedical instrument for the measurement of multiple physiological variables of sleep

Prescribed CPAP Pressure - pressure(s) or settings determined by a CPAP titration sleep study, which a physician prescribes for a patient's CPAP therapy machine

Pulse Oximetry - non-invasive measure of oxygen saturation; that is the amount of oxygen saturated in the hemoglobin in terms of percentage; not as accurate as the values obtained from an arterial blood gases (ABG) test and should only be used as a gauge of oxygenation. Normal ranges are between 95-100%.

RDI - Respiratory Disturbance Index, includes all respiratory events per hour.

REM sleep, rapid eye movement sleep - sleep characterized by the active brain waves, flitting motions of the eyes, and weakness of the muscles; most dreaming occurs in this stage, which accounts for about 20% of sleep in adults.

REM Density - A function that expresses the frequency of eye movements per unit of time during REM sleep.

REM-Associated Disorders - Sleep disturbances that occur in REM sleep.

REMS latency - The period of time in the sleep period from sleep onset to the first appearance of stage REMS.

REM Motor Atonia - The active suppression of activity in the antigravity and voluntary muscles during REM sleep. The muscles are completely flaccid and limp.

REM onset - designation for commencement of a REM period; used also as a shorthand term for a sleep-onset REM period

REM period - REM portion of an NREM-REM cycle; early in the night it may be as short as a half-minute, whereas in later cycles longer than an hour.

REM rebound or recovery - lengthening and increase in frequency and density of REM periods, which results in an increase in REM percent above base line. REM rebound follows REM deprivation once the inhibitory influence is removed

REM Sleep Behavior Disorder (RBD)- disorder in which REM motor atonia is partially or completely absent and the individual acts out the ongoing dream. The behavior in REM behavior disorder is often correlates with the ongoing, hallucinatory REM dream episode.

REM Sleep Episode - REM sleep portion of an NREM-REM sleep cycle. Early in the first sleep period, episodes may be only several minutes in duration. Later REM episodes almost are always longer, 20 to 30 minutes up to an hour.

REM Sleep Intrusion - brief interval of REM sleep appearing out of its usual positioning in the NREM-REM sleep cycle.

REM Sleep Latency - interval from sleep onset to the first appearance of REM sleep

REM Sleep Onset - designation for the first epoch of a REM sleep episode

REM Sleep Percent - proportion of total sleep time occupied by REM sleep

REM Sleep Rebound - compensatory increase in REM sleep following experimental reduction. Extension of time in, and an increase in frequency and density of REM sleep episodes; usually an increase in REM sleep percent of total sleep time above baseline values

Restless Legs Syndrome (RLS) - sleep disorder characterized by a deep creeping, or crawling sensation in the legs that tends to occur when an individual is not moving. There is an almost irresistible urge to move the legs; the sensations are relieved by movement.

Shiftwork - working hours outside of the conventional daytime hours of 9:00 a.m. to 5:00 p.m.

Sleep - a state marked by lessened consciousness, lessened movement of the skeletal muscles, and slowed-down metabolism

Sleep Apnea - cessation of breathing for 10 or more seconds during sleep

Sleep architecture - NREM/REM stage and cycle infrastructure of sleep understood from the vantage point of the quantitative relationship of these components to each other

Sleep cycle - synonymous with NREM-REM cycle

Sleep Disorders - broad range of illnesses arising from many causes, including, dysfunctional sleep mechanisms, abnormalities in physiological functions during sleep, abnormalities of the biological clock, and sleep disturbances that are induced by factors extrinsic to the sleep process

Sleep onset - transition from wake to sleep, normally into NREM stage 1 (but in certain conditions, such as infancy and narcolepsy, into stage REMS)

Sleep-onset REM period - atypical beginning of sleep by entrance directly into stage REM

Sleep paralysis - waking and not being able to move for a short period of time, usually occurs out of REM (dream) sleep.

Sleep pattern (24 hour sleep-wake pattern) - individual's clock hour schedule of bedtimes and rise times as well as nap behavior: may also include time and duration of sleep interruptions

Sleep stage NREM - major sleep state apart from REMS; comprises sleep stages 1-4

Sleep stage 1 - a stage of NREM sleep occurring after wake. Its criteria consist of a low-voltage EEG with slowing to theta frequencies, alpha activity less than 50%, EEG vertex spikes, and slow rolling eye movements; no sleep spindles, K-complexes, or REMS. Stage 1 normally assumes 4-5% of total sleep.

Sleep stage 2 - a stage of NREM sleep characterized by sleep spindles and K complexes against a relatively low-voltage, mixed-frequency EEG background; high-voltage delta waves may comprise up to 20% of stage 2 epochs; usually accounts for 45-55% of total sleep time.

Sleep stage 3 - a stage of NREM sleep defined by at least 20 and not more than 50% of the period (30 second epoch) consisting of EEG waves less than 2 Hz and more than 75 uV (high-amplitude delta waves); a "delta" sleep stage; with stage 4, it constitutes "deep" NREM sleep; appears usually only in the first third of the sleep period; usually comprises 4-6% of total sleep time.

Sleep stage 4 - all statements concerning NREM stage 3 apply to stage 4 except that high-voltage, slow EEG waves, cover 50% or more of the record; NREM stage 4 usually takes up 12-15% of total sleep time. Somnambulism, sleep terror, and sleep-related enuresis episodes generally start in stage 4 or during arousals from this stage

Sleep stage REM - the stage of sleep found in all mammal studies, including man, in which brain activity is extensive, brain metabolism is increased, and vivid hallucinatory imagery, or dreaming occurs (in humans). Also called "paradoxical sleep" because, in the face of this intense excitation of the CNS and presence of spontaneous rapid eye movements, resting muscle activity is suppressed. The EEG is a low-voltage, fast-frequency, non-alpha record. Stage REMS is usually 20-25% of total sleep time.

Sleep structure - similar to sleep architecture. Sleep structure, in addition to encompassing sleep stage and cycle relationships, assesses the within-stage qualities of the EEG and other physiological attributes.

Sleepiness (somnia, drowsiness) - difficulty in maintaining the wakeful state so that the individual falls asleep if not actively kept aroused; not simply a feeling of physical tiredness or listlessness

Sleep talking - talking in sleep takes place during stage REMS, representing a motor breakthrough of dream speech, or in the course of transitory arousals from NREMS and other stages. Full consciousness is not achieved and no memory of the event remains.

Sleepwalker or Sleepwalking - individual subject to somnambulism (one who walks while sleeping). Sleepwalking typically occurs in the first third of the night during deep NREM sleep (stages 3 and 4).

SmartPAP (Smart CPAP) - (Smart [Continuous] Positive Airway Pressure) Medical device used in the treatment of obstructive sleep apnea providing preset levels of continuous airflow, and automatically adjusting to keep the breathing passages open by sensing changes in airway integrity. The air flows from the device through a tube that connects to a nose or facemask.

Snoring - noise produced primarily with inspiratory respiration during sleep owing to vibration of the soft palate and the pillars of the oropharyngeal inlet. Many snorers have incomplete obstruction of the upper airway, and may develop obstructive sleep apnea.

Somnambulism - walking while asleep

Somnolence - prolonged drowsiness or sleepiness.

Synchrony - scheduling sleep to synchronize with the biological clock

Tidal Volume - amount of air that passes in and out of the lungs in an ordinary breath; usually expressed in liters

Titration - progressive, stepwise increase in CPAP pressure applied during a polysomnogram to establish the optimal treatment pressure

Transducer - device designed to convert energy from one form to another

Transient Arousals - brief awakenings from sleep

Transient Insomnia - difficulty sleeping for only a few nights.

Unattended CPAP Titration Study - sleep study that is usually performed in the home, after determining that a patient has a sleep related breathing disorder such as OSA or Upper Airway Resistance Syndrome, and is likely to benefit from CPAP therapy.

Upper Airway - part of the respiratory anatomy that includes the nose, nostrils, sinus passages, septum, turbinates; the tongue, jaws, hard and soft palate, muscles of the tongue and throat, etc.

Upper Airway Resistance Syndrome (UARS) - part of the spectrum of obstructive sleep-related breathing disorders in which repetitive increases in resistance to airflow in the upper airway lead to brief arousals and daytime fatigue. Apneas and hypopneas (see RDI) may be totally absent. Blood oxygen levels can be in the normal range.

Uvulopalatopharyngoplasty (UPPP) - also abbreviated as UPP or UP3 this operation is performed on the throat to treat snoring and sleep apnea. UPPP is an accepted means of surgical treatment has a curative rate of less than 50%. Scientific evidence suggests that UPPP works best in retropalatal and combination retropalatal and retrolingual obstruction

Zeitgeber - environmental time cue that entrains biological rhythms to a specific periodicity. Known Zeitgebers are light, melatonin and physical activity. To be effective, these signals must occur when the biological clock is in a responsive phase.

Abbreviations

AHI – Apnea/Hypopnea Index

AI – Apnea Index

APAP (Auto-CPAP) - auto-titrating, self-adjusting device

Bi-PAP (BPAP) - Trademark name of a Bi-Level cpap machine.

BMI – Body Mass Index

C - Cataplexy

CPAP - Continuous Positive Airway Pressure (a nasal device to relieve obstructed breathing in a sleeping patient)

CSR – Cheyne-Stokes respiration

DAU – Data Acquisition Unit

DME - Durable Medical Equipment

DOES – Disorders of Excessive Somnolence

DSPS - Delayed Sleep Phase Syndrome

EDA – Event Detection Algorithm

EDS - Excessive Daytime Sleepiness

EEG – Electroencephalogram

EKG - Electrocardiogram

EMG – Electromyogram

ENT – Ear, nose, and throat

ENT - Ear, Nose, and Throat

GABA - Gamma-Aminobutyric Acid

GERD – Gastroesophageal Reflux Disease

IH - Idiopathic Hypersomnia

IPAP - Inspiratory Positive Airway Pressure

LMN - Letter of Medical Necessity

MSLT - Multiple Sleep Latency Test

N – Narcolepsy

NREM – Non-Rapid Eye Movement (sleep)

O₂ - Oxygen

OSA - Obstructive sleep apnea

OSAS - Obstructive sleep apnea syndrome

PLMD - Periodic Leg Movement Disorder or Periodic Leg Movements of Sleep

PSG - Polysomnogram

RERA – Respiratory effort-related arousal

RBD – Rem Behavior Disorder

RDI – Respiratory Disturbance Index

REM - Rapid Eye Movement (sleep)

RLS - Restless Leg Syndrome

SDB - Sleep disordered breathing

UARS – Upper Airway Resistance Syndrome

UPPP - Uvulopalatopharyngoplasty

